T.R.
USKUDAR UNIVERSITY
INSTITUTE OF HEALTH SCIENCE

DEPARTMENT OF NEUROSCIENCE
MASTER'S DEGREE PROGRAM OF NEUROSCIENCE
MASTER'S DEGREE THESIS

THE EFFECT OF CHANGES IN BELIEFS AND PATTERNS OF THOUGHT ON HORMONE LEVELS IN INDIVIDUALS HAVING PROFESSIONAL COACHING

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ABSTRACT

THE EFFECT OF CHANGES IN BELIEFS AND PATTERNS OF THOUGHT ON HORMONE LEVELS IN INDIVIDUALS HAVING PROFESSIONAL COACHING

This study examines the neurobiochemical and emotional impacts of professional coaching by assessing alterations in dopamine and norepinephrine levels, along with affective states, prior to and following a single coaching session. It examines how alterations in belief systems and cognitive patterns during coaching may affect the brain's neurotransmitter activity related to reward and stress.

The major objective is to evaluate if a one-hour coaching session may provide quantifiable alterations in hormone levels and emotional states, thus enhancing the comprehension of coaching as a neuroscience-informed intervention.

A single-group pretest-posttest design was employed. Fifteen adult volunteers with previous coaching experience participated. Plasma dopamine and norepinephrine concentrations were quantified using high-performance liquid chromatography (HPLC), and mood was evaluated with the Positive and Negative Affect Schedule (PANAS) prior to and following the session.

Although changes in hormone levels did not achieve statistical significance, a relative increase in dopamine and a reduction in norepinephrine were noted. Notable disparities were observed in PANAS scores: positive affect exhibited an increase ($p=0.002$), while negative affect demonstrated a decrease ($p=0.006$). A notable inverse association was seen between dopamine levels and negative affect scores.

These findings indicate that a solitary coaching session may provide immediate psychological and possible physiological advantages. Future research including bigger sample sizes and repeated interventions is advised to corroborate and enhance these findings. Furthermore, the inclusion of other neurotransmitters and neuroimaging methodologies may enhance comprehension of coaching's effects on cerebral function and neuroplasticity.

Keywords: Change, Coaching, Hormones, Motivation, Neuroscience

ÖZET

PROFESYONEL KOÇLUK ALAN BİREYLERDE İNANÇ VE DÜŞÜNCE KALIPLARI DEĞİŞİMİNİN HORMON DÜZEYLERİ ÜZERİNDEKİ ETKİSİ

Bu çalışma, tek bir koçluk seansından önce ve sonra dopamin ve norepinefrin düzeylerindeki değişiklikleri ve duygusal durumları değerlendirerek profesyonel koçluğun nörobiyokimyasal ve duygusal etkilerini incelemektedir. Koçluk sırasında inanç sistemleri ve bilişsel kalıplardaki değişikliklerin, ödül ve stresle ilgili beyin nörotransmitter aktivitesini nasıl etkileyebileceğini incelemektedir. Ana amaç, bir saatlik koçluk seansının hormon seviyelerinde ve duygusal durumlarda ölçülebilir değişiklikler sağlayıp sağlamadığını değerlendirmek ve böylece koçluğu nörobilim temelli bir müdahale olarak daha iyi anlamaktır.

Tek gruplu ön test-son test tasarımı kullanılmıştır. Daha önce koçluk deneyimi olan 15 yetişkin gönüllü katılmıştır. Plazma dopamin ve norepinefrin konsantrasyonları yüksek performanslı sıvı kromatografi (HPLC) kullanılarak ölçülmüş ve seans öncesinde ve sonrasında ruh hali Pozitif ve Negatif Duygu Ölçeği (PANAS) ile değerlendirilmiştir.

Hormon düzeylerindeki değişiklikler istatistiksel olarak anlamlı bulunmamıştır. Buna karşılık dopamin düzeyinde göreceli bir artış ve norepinefrin düzeyinde ise azalma gözlendi. PANAS puanlarında istatistiksel anlamlı sonuçlar elde edildi: pozitif duygu artarken ($p=0,002$), negatif duygu azaldı ($p=0,006$). Ve dopamin düzeyleri ile negatif duygu puanları arasında dikkate değer bir ters ilişki gözlendi.

Bu bulgular, tek bir koçluk seansının anında psikolojik ve olası fizyolojik faydalar sağlayabileceğini göstermektedir. Bu bulguları doğrulamak ve geliştirmek için daha büyük örneklem grupları ve tekrarlanan müdahaleleri içeren gelecekteki araştırmalar önerilmektedir. Ayrıca, diğer nörotransmiterlerin ve nörogörüntüleme yöntemlerinin dahil edilmesi, koçluğun beyin fonksiyonu ve nöroplastisite üzerindeki etkilerinin daha iyi anlaşılmasını sağlayabilir.

Keywords: Değişim, Hormonlar, Koçluk, Motivasyon, Nörobilim,

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FORM OF DECLARATION

Herewith I declare, that I obtained all the information and documents in this study within the framework of academic rules, presented all visual, auditory, and written information and results in accordance with scientific ethics, did not falsify the data I used, referred to the sources I used in accordance with scientific norms, that my thesis was original except in the cases cited, produced by me and written in accordance with the Thesis Writing Guide of Uskudar University Institute of Health Sciences.

23.06.2024

Kemal BASARANOGLU
Signature

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AC : Association for Coaching

ACC: Anterior Cingulate Cortex

CRH: Corticotropin-Releasing Hormone

DA: Dopamine

EMCC : European Mentoring & Coaching Council

HPA: Hypothalamic Pituitary Adrenal

HPLC: High-Performance Liquid Chromatography

IAC : International Association of Coaching

ICF : International Coaching Federation

NAc: Nucleus Accumbens

NE: Norepinephrine

PANAS : Positive and Negative Affect Schedule

PCC: Posterior Cingulate Cortex

TRH: Thyrotropin Releasing Hormone

VTA: Ventral Tegmental Area

1. INTRODUCTION

Coaching is fundamentally a dialogue process grounded in mutual rapport and trust. An individual seeks coaching either to address a challenge or to unlock potential. In both instances, the objective is to attain improved conditions. Numerous research indicates that coaching in non-professional settings helps alleviate anxiety, stress, and depression, while enhancing hope, well-being, resilience, and facilitating goal attainment. (Grant et al., 2009).

Neuroplasticity refers to the capacity of neurons and neural networks to form connections and alter their activity in response to acquired knowledge. Plasticity denotes the concept that the robustness of synaptic connections across neurons is variable, enhancing with utilization and diminishing with disuse. Dweck (2007) posits that cognitive frameworks encompass the assumption that an individual's traits may either be fully cultivated and altered (growth mindset) or are entirely immutable and unchangeable (fixed mindset) (Gholami et al., 2022).

Dopamine (DA) is commonly known as the "pleasure" neurotransmitter; however it also governs motivation, interest, pleasure, attention, concentration, memory, prioritization, and alertness. Norepinephrine is associated with survival responses including fight-or-flight reactions, alertness, interest, wakefulness, vigilance, attention, emotional control, energy, psychomotor agitation, cognition, memory, apathy, weariness, and tremors (Freeman, 2016).

1.1. Purpose and Importance of the Research

It is aimed to scientifically measure whether there are changes in mood that will occur with a certain emotion measurement scale depending on hormone levels before and after coaching.

The aim of this study was to show hormonal changes in mental processes during a one-hour coaching session. To question this change, dopamine (reward) and norepinephrine (stress) levels will be measured. It is already known that during a good coaching session clients experience significant changes in their belief systems and thought patterns. These changes should have clear neurobiochemical reflections. The aim of this project is to assess changes in the brain's reward, happiness and stress chemistry through a coaching session intervention. It is also aimed to evaluate the effect of coaching sessions on the “Positive and Negative Affect Schedule (PANAS)”, which is a representation of emotional expressions.

1.1.1. Main Objective of the Study

To investigate whether hormonal alterations in cognitive functions transpire following a one-hour coaching session. To examine this alteration, we assessed dopamine and norepinephrine levels prior to and following coaching.

1.1.2. Secondary Objective of the Study

To evaluate alterations in mood pre- and post-coaching, contingent upon hormone levels, utilizing a designated mood assessment tool (PANAS).

1.2. Research Questions and Hypotheses

Hypothesis 1: A one-hour coaching session changes the levels of dopamine and norepinephrine in mental processes.

Hypothesis 2: There are changes in mood on the PANAS scale before and after coaching.

2. GENERAL INFORMATION

2.1. Coaching

2.1.1. What is Coaching?

Coaching has been since the 1990s and continues to develop as a profession, assisting individuals, teams, and organizations in attaining their objectives. Professional associations and practitioners in coaching have yet to reach a consensus on a unified definition (English, Sabatine, and Brownell. , 2022:41). Some of these associations define coaching as follows:

The International Coaching Federation (ICF) defines coaching as a practice that fosters collaboration through a questioning and thought-provoking approach, aimed at motivating individuals to optimize their potential in alignment with personal and professional requirements (ICF, 2025).

The Association for Coaching (AC) defines coaching as a discipline that enhances individuals' or organizations' awareness, fosters a sense of responsibility, and clarifies decision-making through dialogue and questioning techniques, focusing on their thoughts and behaviors (AC, n.d.).

Coaching, as defined by the European Mentoring & Coaching Council (EMCC), is an art that facilitates individuals or groups in their pursuit of professional objectives, interpersonal connections, and the realization of their own potential (EMCC, n.d.).

The International Association of Coaching (IAC) defines coaching as a transforming practice that broadens possibilities and encompasses personal and professional realization, discovery, and development (IAC, n.d.).

2.1.2. What is the origin of coaching?

The term “coach” originates from the town of Koc, pronounced “kotch,” which manufactured horse-drawn carriages in Hungary during the 15th century. The initial application of the term in scholarly contexts occurred at Oxford University during the

1830s. In this context, "coach" denotes a teacher who assists students with their academic endeavors and also refers to an instructor guiding a student from one location to another, facilitating their progress or preparing them for examinations (O'Connor and Lages, 2019: xiii)

Over the past three decades, the employment landscape has transformed. Employees can no longer retire after commencing employment. This is attributable not just to a deficiency of employment but also to economic, social, and cultural transformations. As employees enhance their skills, their value increases. At this juncture, coaching assists employees in making higher quality and accurate decisions (O'Connor and Lages, 2010: 26).

2.1.3. What is the role of a coach in the coaching process?

Coaching is a professional relationship between the coach and the client, characterized by a partnership that fosters innovation. The coach's objective is to activate resources that the coachee was unaware of or had overlooked, facilitating internal development and growth. An adept coach fosters an environment that encourages the coachee to interrogate and extend their limitations, to surpass them, to assume responsibility for various aspects of life, and to be answerable for them. The coach's role at this juncture is not to dwell on errors and shortcomings, but to assist the coachee in identifying their strengths, enhancing their capabilities in this regard, actively implementing them across various facets of life, and guiding them on the path to becoming their optimal self (ICF, 2025).

Erickson Coaching International, an ICF-accredited institution, defines a coaching session as an arrow. This session encompasses the following elements (Atkinson, 2018).

1. Rapport: This pertains to the process of cultivating the relationship between the coach and the coachee, fostering closeness and trust.
2. Contract: The coachee's agenda for discussion during the session that day.
3. Outcome Framework: This phase of the coaching procedure delineates your objectives and elucidates the methods by which you will comprehend their attainment.
4. Creating Experience: This part includes open-ended questions for the coach that promote Socratic thinking while facilitating their realization of the desired goal through future visualization.

5. Reviewing Action Steps: This section delineates the action stages that will guide the coachee toward the intended objective.
6. Asking Value: This segment facilitates the coachee's recognition of their acquired knowledge and its applicability across all aspects of their life.
7. Celebration: Upon concluding the coaching process, the coach reiterates the value attained by the coachee at the session's end and expresses gratitude to the coachee.

2.1.4. What are the benefits of coaching services?

In the early 2000s, coaching mostly aimed to rectify undesirable habits, whereas today it emphasizes the development and optimization of potential. The Harvard Business Review performed a study including 140 coaches. This research identified three reasons organizations favor coaches (Coutu and Kauffman, 2009) ;

1. Cultivating strong potentials

2. Establish an advisory council to deliberate on concepts.

3. Rectifying deviations from established norms of detrimental behaviors arising from heightened stress, complacency, or insufficient self-reflection by the leader.

2.1.5. Coaching is distinct from both mentoring and therapy.

Mentoring is a partnership between a knowledgeable and senior individual (the mentor) and a less experienced individual (the mentee). This relationship aims to enhance the mentee's advancement in the pertinent employment, profession, or organization. In this approach, the mentor imparts the experience, information, and insights required by the mentee, whereas coaching does not involve the transfer of experience. **Therapy** is a psychological counseling service primarily aimed at addressing psychological issues. The emphasis is typically on mental wellness. The therapeutic working horizon is more extensive than that of coaching. Coaches assume a more facilitative role (Passmore and Sinclair, 2020).

2.2. Connection between Coaching and Neuroscience

Neuroscience encompasses the development, structure, and functionality of the brain and nervous system. It examines the entire system in relation to any detrimental neurological, psychiatric, or neurodevelopmental issue. This extensive field establishes a crucial basis for coaching and enables coaches to gain a comprehensive perspective. From a coaching standpoint, neuroscience can succinctly elucidate the mechanisms and rationale for the efficacy of coaching. It can enable instructors to instruct with greater competence and precision. Given that all processes originate in the brain, it has become an essential domain of study for those engaged in fields related to the human brain, such as coaching. The prospective contributions of neuroscience to the field of coaching are (Brann, 2022:1):

- Comprehending the dynamics of the coaching process,
- Establishing optimal conditions for coaches
- Comprehending the unique memorized coaching models and their operational logic, while integrating these models with contemporary neuroscience principles and discarding ineffective models.
- Conducting more health-conscious assessments through cognitive awareness
- Enhancing the coaching process through improved quality of questions and interventions.
- Offers the chance to concentrate on the pertinent aspects, neuroscience can provide important insights into the deeper mechanisms of coaching, contributing to the development, change and transformation processes of the coachee. This results in a more effective, coachee-oriented interactive process between the coach and the coachee. (Boyatzis and Jack, 2018)

The subsequent notions from neuroscience are crucial for coaching.

2.2.1. Neuroplasticity

For many years, it was believed that the brain and the human being attached to it have a set, immutable essence. Three significant causes underpinned this.

1. Patients infrequently recuperated from a cerebral injury.

2. The in vivo monitoring of the microscopic activity of the human brain was

conducted,

3. Since the era of Descartes, the brain has been compared to a machine.

Machines are incapable of self-improvement or self-modification, regardless of

their performance quality.

When patients fail to achieve the anticipated psychological improvement, it is posited that their brain has not undergone alteration (Doidge, 2019: xx).

The conveyance of information occurring in the brain's synapses is termed synaptic neuroplasticity. Synaptic neuroplasticity pertains to the mechanisms via which individuals develop various habits and skills. For instance, acquiring a sport, mastering a new language, or developing a substance dependency. For a synaptic connection to form, neurons on both sides must be concurrently active. This guarantees the continuous and robust transmission of the signal across the synaptic cleft. The neuron preceding the synapse is termed the presynaptic neuron, while the neuron succeeding the synapse is referred to as the postsynaptic neuron. The presynaptic neuron consistently initiates firing first, allowing the signal to propagate. This principle, termed Hebb's law, was introduced by Canadian psychologist Donald Hebb: “Neurons that fire together form connections together.” This denotes long-term potentiation (O’Connor and Lages, 2010: 18).

Neuroplasticity is fundamental to coaching. The primary success criterion in coaching procedures is linked to behavioral change and learning. A coaching procedure devoid of neuroplasticity will merely constitute a surface endeavor, lacking efficacy in the neuroscientific mechanisms governing thoughts and behaviors. The Hebbian principle asserts that inactivity implies the occurrence of an action. If new brain networks are not being developed, existing networks are being reinforced and enhanced. Consequently, coaching and therapy that fail to facilitate neuroplastic change are ineffective for clients and perpetuate inertia. (21 Triangle, n.d.).

2.2.2. Cortex

Cortex refers to a shell. The cerebral cortex of the human brain possesses a complicated architecture. It comprises sulci (narrow grooves), fissures (broad grooves), and gyri (elevated ridges between sulci or fissures). Approximately two-thirds of the cortical surface is concealed within these sulci, with a total surface area of approximately

2.360 m² and a thickness of roughly 3 mm. The cerebral cortex comprises glial cells, neuronal cell bodies, dendrites, and axons that establish connections among neurons (Carlson, 2022: 67).

2.2.2.1. Lobes of Cortex

The cerebral cortex comprises four lobes, named after the cranial bones. The frontal lobe encompasses all regions anterior to the central sulcus. Parietal lobe; situated posterior to the central sulcus, inferior to the frontal lobe. The temporal lobe is located anterior to the brainstem, inferior to the frontal and parietal lobes. The occipital lobe is situated at the posterior aspect of the brain, posterior to the parietal and temporal lobes (Carlson, 2022: 67). The positioning and functions of these four lobes in the skull are as follows in Figure 1 (Patestas and Gartner, 2016: 489).

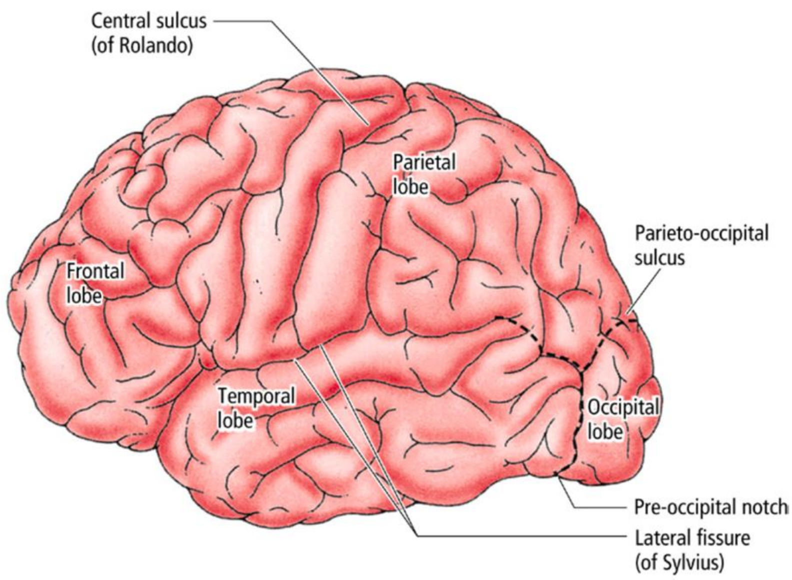

Figure 1: Lateral perspective of the brain displaying four of the five lobes of the cerebrum (Patestas and Gartner, 2016).

Frontal lobe: Situated at the anterior of both cerebral hemispheres, posterior to the frontal region. It pertains to motor control, cognitive functions, emotional processing, and the motor components of language.

Parietal lobe: Situated in the upper-middle region of the brain, posterior to the frontal lobe and anterior to the occipital lobe. It is symmetrically situated in both cerebral hemispheres. It is engaged in sensory function, processing perceptions of touch, pressure, pain, temperature, and proprioception.

Temporal lobe: Situated inferior to the frontal and parietal lobes, posterior to the temporal bones. It encompasses cortical regions. It processes the sensory dimensions of auditory perception, memory, emotions, and language.

Occipital lobe: Situated posteriorly in the brain, posterior to the parietal and temporal lobes. It operates in the processing of visual data..

2.2.2.2. Coaching and Cortex Relationship

The Coaching techniques provide a framework designed to enhance cognitive awareness, elevate emotional intelligence, promote behavioral change, and facilitate personal development. The achievement of these objectives is facilitated by the intricate functional interactions of neurobiological mechanisms inside the individual's central nervous system, particularly the cerebral cortex. The cerebral cortex is the most evolutionarily sophisticated area of the human brain, serving as the principal hub for high-level cognitive activities like thought, perception, planning, decision-making, attention, empathy, language, and memory. These cognitive functions constitute the neurological foundation for the essential coaching qualities delineated by the ICF. The Core Competency Model, revised by ICF in 2019, organizes the coaching process into four primary categories:

1. Core Competencies,
2. Building Relationships,
3. Effective Communication,
4. Supporting Learning and Development.

Each of these subjects pertains to cognitive and neurophysiological mechanisms that intersect with various lobes of the cerebral cortex (Carlson, 2022; ICF, 2019; Patestas and Gartner, 2016).

Frontal Lobe and Executive Functions: The frontal lobe governs executive activities including planning, problem-solving, rational decision-making, emotional regulation, and moral reasoning. The successful execution of the competencies categorized as “Internalizes the Coaching Mind-Set,” “Creates Awareness,” and “Facilitates Client Development” necessitates the active engagement of the frontal brain. The frontal lobe is essential since it assists the client in identifying their cognitive habits, formulating fresh alternatives, and devising different decision-making techniques. This indicates that the coaching process possesses both a psychological and a neuroscientific foundation.

Parietal Lobe and Sensory Integration: The parietal lobe processes sensory information, including tactile perception, pressure, temperature, pain, and proprioceptive awareness, while also influencing the individual's awareness of their environment. In the context of ICF's “Active Listener” competency, the coach's ability to perceive and evaluate both verbal and non-verbal communication cues from the client is closely linked to the sensory integration function of the parietal cortex. This function enhances the coach's comprehension of the client's requirements.

Temporal Lobe and Social-Cognitive Functions: The temporal lobe facilitates auditory perception, memory processes, language comprehension, and emotional regulation. Competencies like "Builds Trust and Confidence" and "Maintains Coach Position" necessitate the coach to communicate empathetically and comprehend the client's emotional processes. The interplay of the temporal lobe, particularly with limbic structures such as the amygdala, constitutes the neurophysiological foundation for the emotional intelligence cultivated during coaching.

Occipital Lobe and Visual Perception: The occipital lobe is involved in the processing of visual information. The occipital brain facilitates the client's comprehension of metaphors, images, and visual representations employed during the coaching process, enabling the creation of internal imagery. This represents the neurobiological equivalent of the creative methods employed in the "Creates Awareness" skill.

2.2.3. The Limbic System and the Role of the Amygdala in Coaching: A Neuroscientific Perspective

2.2.3.1. Anatomy and Function of the Limbic System

A collection of brain regions known as the limbic system are typically found above the brainstem, beneath the cerebral cortex, and lateral to the thalamus. The term "grand lobe limbique" was originally used to describe this general area of the brain in

1878 by Paul Broca. It was later dubbed the limbic lobe in 1949 by American neuroscientist and physician Paul D. MacLean, while more modern terms are now used to refer to the various components that make up this area. It was eventually discovered that this area of the brain is connected to processes related to motivation, emotion, and memory that link to other areas of the brain. Clinically, certain illnesses arise from lesioning sections of the limbic system. Even while we still don't fully comprehend the limbic system, breakthroughs in neuroscience have helped us better grasp the roles that each of its numerous components plays as well as some of their linkages (National Library of Medicine, 2023). Key components of the limbic system (Figure 2 – 3):

- **Amygdala**: There are several essential components of the limbic system.The amygdala is a multifaceted structure that is situated inside the limbic system and is responsible for processing a variety of stimuli. There are around ten to thirteen cortical and subcortical nuclei that make up the amygdala in mammals. These nuclei are responsible for a variety of functions and connections spread throughout the limbic system and the sensory cortex. It is generally known that the subcortical regions of the amygdala, such as the anterior, medial, and anterior amygdala, regulate behavioral activities that involve many aspects of emotion, fear processing, and social interaction. These structures have been the subject of much research (Sedwick and Autry, 2022).

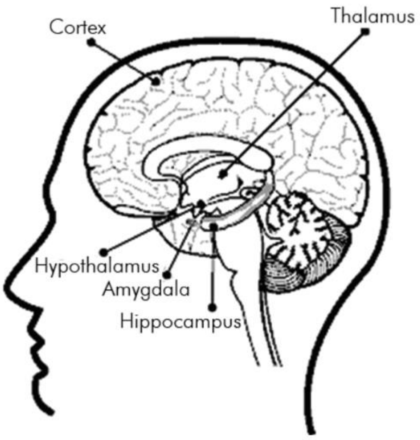

Figure 2: Homo sapiens sapiens cerebrum(Pittman and Karle, 2015)

- **Hippocampus**: The hippocampus is a sophisticated brain structure located deep within the temporal lobe. The hippocampus is an outgrowth of the temporal lobe of the cerebral brain. Externally, it is identifiable as a dense layer of neurons arranged in an S-shaped curve at the boundary of the temporal lobe. Consequently, it is referred to as a component of the limbic lobe (limbic signifies "border"). Despite being a subcortical structure, it is not regarded as wholly subcortical. It constitutes a component of the hippocampus formation and possesses several extensions. It is essential for learning and memory. It is a flexible and delicate structure susceptible to injury from numerous stimuli. Studies indicate that the hippocampus is influenced by numerous neurological and mental conditions (Anand and Dhikav, 2012).

- **Hypothalamus**: The hypothalamus is the area in the ventral brain that regulates the endocrine system. It receives numerous signals from diverse brain regions and subsequently releases both releasing and inhibiting hormones, which act on the pituitary gland to regulate the functions of the thyroid gland, adrenal glands, and reproductive organs, as well as to influence growth, fluid balance, and lactation. It also participates in non-endocrine processes such as temperature regulation, autonomic nervous system modulation, and hunger control. The hypothalamus operates in tandem with the pituitary gland via the hypothalamic-pituitary axis. The hypothalamus has many neuron types that secrete distinct hormones. The thyrotropin-releasing hormone (TRH), gonadotropin-releasing hormone (GnRH), growth hormone-releasing hormone (GHRH), corticotropin-releasing hormone (CRH), somatostatin, and dopamine are secreted from the hypothalamus into the bloodstream, where they reach the anterior pituitary (National Library of Medicine, 2023).

- **Anterior Cingulate Cortex (ACC)**: The anterior cingulate cortex is a component of the cingulate cortex, which encircles the corpus callosum and is conventionally considered one of the most substantial regions of the limbic system (Figure 3). The structure can be broadly categorized into an anterior region, which is implicated in emotional and motor functions, and a posterior region (posterior cingulate cortex; PCC), which is associated with visuospatial and memory functions. The ACC warrants a more comprehensive description due to its function in the internal action path. The ACC encompasses a substantial area surrounding the rostrum of the corpus callosum and is distinguished by prominent layer V neurons, including big pyramidal neurons (Krieghoff et al., 2011).

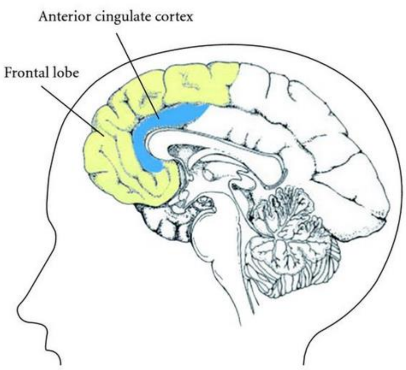

Figure 3 : Graphical representation of the sagittal view of the frontal lobe and the anterior cingulate cortex in a human brain (Reich, 2023)

2.2.3.2. The Limbic System in Coaching Practice

In a constantly evolving environment faced with various challenges, resilience and coping mechanisms are essential for overcoming difficulties and restoring equilibrium. Coaching, previously focused on personal awareness and behavioral change, now plays a crucial role in fostering resilience and coping strategies. (Jouali et al., 2024).

Emotions are critical in influencing performance outcomes. Coaching emphasizes performance and can be influenced by emotional factors. The ability to effectively regulate emotions impacts performance outcomes, individual well-being, and interpersonal relationships. Personality traits influence interpersonal emotion regulation and relational dynamics. Coaching practices enhance the effectiveness and quality of coaching by activating neurological systems associated with self-regulation and insight in coachees, thereby aiding them in regulating their emotional responses (Davis and Davis: 2015).

These systems are intricately connected to the limbic structures—specifically the amygdala, hippocampus, and anterior cingulate cortex—which affect threat perception, emotional regulation, and the processing of significant change. (Davidson and Begley, 2012; Siegel, 2007). Furthermore, establishing a psychologically secure coaching environment may mitigate stress reactions regulated by the hypothalamic–pituitary–adrenal (HPA) axis, hence facilitating persistent behavioral change (McGonigal, 2015).

a. The Role of the Amygdala in Emotional Regulation during Coaching

In coaching sessions, clients frequently examine aspects of personal discomfort, ambiguity, or transformation. This job can engage the amygdala's "threat detection system," resulting in diminished emotional reaction and rational thought, a condition articulated by Daniel Goleman in his 1996 publication, Emotional Intelligence: Why It can Matters More Than IQ., which is marked by a decline in rational thought and an escalation in emotional responses. The amygdala is essential for recognizing and learning the emotionally relevant elements of our surroundings. They play a crucial role in the development of emotions, particularly adverse emotions like dread. The amygdala is frequently stimulated when individuals detect a possible threat. This activation aids individuals in making decisions informed by pertinent past memories. Effective coaching facilitates coachees' awareness of these triggers and cultivates methods for regulating their emotional responses. In coaching, the amygdala establishes a genuine neurobiological impediment to behavioral modification; effective coaching assists the coachee in mitigating this threat response (Goleman, 1996).

b. The Hippocampus and Insightful Learning

Coaching is fundamentally a process of learning. When coachees recontextualize old experiences or generate new interpretations, the hippocampus is stimulated, facilitating the encoding of insights and the establishment of long-term memories. This technique facilitates the development of novel brain circuits, a fundamental mechanism of neuroplasticity. “Reflection and meaning-making in coaching stimulate the hippocampus, facilitating enduring neural encoding of insights.” (Doidge, 2007; Rock and Page, 2009; Siegel, 2007).

c. Regulation of Stress by the Hypothalamus

Coaching can assist individuals in managing their stress responses by offering a psychologically secure and supportive atmosphere. McGonigal (2015) posits that social connection and mentality can alleviate stress via the HPA axis, and implies that same mechanisms may operate in coaching contexts that prioritize trust and significance.

d. Anterior Cingulate Cortex and Self-Perception

Self-awareness, the foundation of coaching, necessitates that the client actively observe internal states and behavioral inclinations. The ACC is particularly engaged throughout these processes, especially when individuals practice perspective-taking, acknowledge internal tensions, and make deliberate judgments. “Recognition of internal emotional discord activates the anterior cingulate, serving as an indicator of readiness for change.” (Davidson and Begley, 2012).

Finally, understanding the limbic system and its components offers a neurobiological foundation for coaching. By integrating insights from neuroscience—particularly the functions of the amygdala, hippocampus, hypothalamus, and ACC—coaches can more effectively support clients in emotional regulation, cognitive flexibility, learning, and behavior change. The brain does not merely support coaching; it transforms through coaching.

2.2.4. Neurobiochemical Implications of Motivation and Stress: Dopamine and Norepinephrine Dynamics

We should begin by examining our comprehension of the phrase 'neurotransmitter.' As defined by the Oxford English Dictionary (2nd edition), it is: a substance released at the terminus of a nerve fiber upon the arrival of a nerve impulse, which diffuses across the synapse or junction to facilitate the transmission of the impulse to another nerve fiber, muscle fiber, or receptor. A neurotransmitter can undoubtedly exert multiple effects, and a brief contemplation of the complexities involved in your nervous system's facilitation of the processes that allow you to turn the pages of this thesis, as well as read and retain its contents, will illuminate the extensive achievements required of the nervous system and the numerous components that must be engaged and functionally integrated. This does not take into account your emotional state, whether it be contentment, anxiety, or depression, and how it may influence your focus and capacity to read, learn, or even turn the pages. Such processes undoubtedly engage many brain circuits and neuron types, resulting in diverse effects and possibly necessitating several neurotransmitters (Webster, 2001: 4)

Dopamine (DA), norepinephrine (NE), and epinephrine, the three principal catecholamines, exhibit analogous characteristics. All are derivatives of the amino acid tyrosine, contain a catechol component, and involve the enzyme tyrosine hydroxylase in the conversion of tyrosine to dihydroxyphenylalanine (l-DOPA) (Patestas and Gartner, 2016: 50).

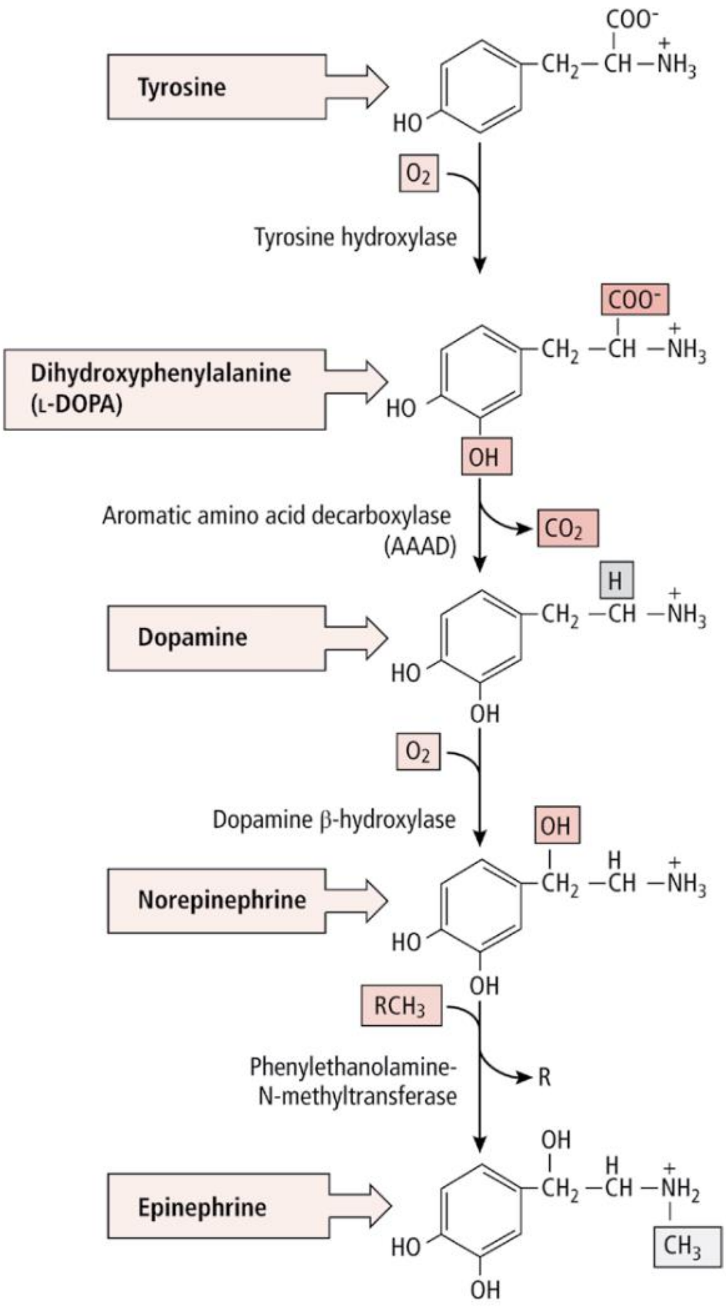

Figure 4 : Production of catecholamines from tyrosine (Patestas and Gartner, 2016).

DA and NE are extensively distributed in regions associated with the representation of the environment and the integration of sensory inputs and motor outputs.

Both are released during periods of novelty and uncertainty, offering credible signal events for the revision of representations and linkages (Harley, 2004).

2.2.4.1. Dopamin

Until the late 1950s, dopamine was regarded solely as a molecule involved in the manufacture of noradrenaline. In 1958, Swedish pharmacologist Arvid Carlsson identified dopamine in the brain, particularly in the striatum, where it was predominantly concentrated. The significance of striatal dopamine was underscored when its near-total depletion was identified as a causative factor in Parkinson's disease throughout the 1960s (Wickens, 2015: 309).

Dopaminergic neurons are medium-sized, non-spiny neurons situated in the midbrain. The dopaminergic neuron axonal projections are extensively branched, with each neurons estimated to produce 1,000,000 terminals. In contrast to other monoamine neurons, DA neurons exhibit distinct projections, whereby axons targeting the dorsal striatum do not collateralize to the ventral striatum or the neocortex. This indicates that each group of DA neurons serves a distinct function inside its target area. Electrophysiological investigations have demonstrated that dopamine neurons establish their own baseline activity states and display pacemaker conductances that facilitate action potential production; this pacemaker drive is also observable in vitro in brain slices. In the absence of inputs, the pacemaker conductance regulates DA neurons in a consistently regular firing pattern (Grace, 2008).

Dopamiergic Neural Systems: The brain contains many dopaminergic neuronal systems. The three most significant of these arise from the midbrain (Carlson, 2022: 102, Nummenmaa et al., 2016).

1. The cell bodies of the nigrostriatal system reside in the substantia nigra and extend their axons to the neostriatum, comprising the caudate nucleus and putamen. The neostriatum is a crucial component of the basal ganglia for movement regulation.
2. The cell bodies of the mesolimbic system reside in the ventral tegmental area and extend their axons to multiple regions of the limbic system, including the nucleus accumbens, amygdala, and hippocampus (the prefix “meso” denotes the midbrain or mesencephalon). The nucleus accumbens is crucial in the

conditioning effects induced by diverse stimuli, including addictive substances.

3. The cell bodies of the mesocortical system are situated in the ventral tegmental region. These extend their axons to the prefrontal cortex. These neurons provide an excitatory influence on the frontal cortex and are thus implicated in tasks such as short-term memory, planning, and problem-solving abilities.

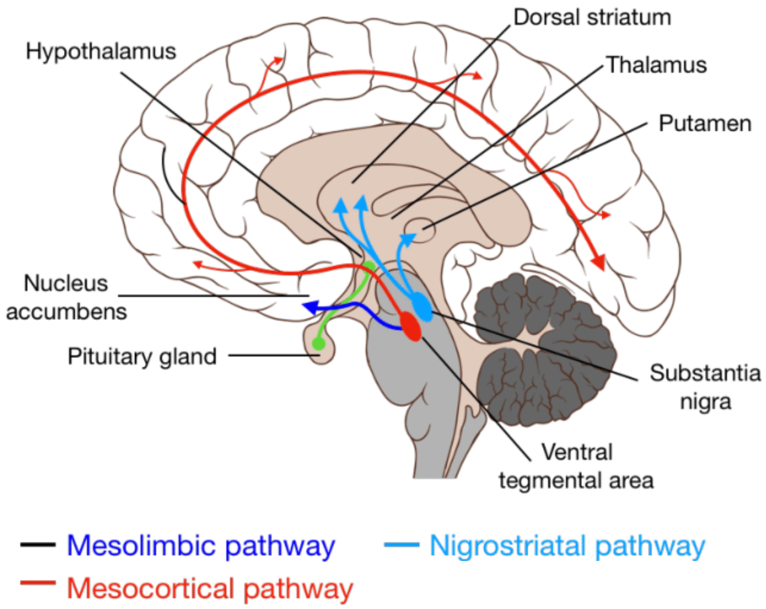

Figure 5 : The primary three dopamine pathways in the brain (Nummenmaa, Seppälä and Putkinen, 2016).

2.2.4.2 Norepinefrin

Norepinephrine, or noradrenaline, was first found in the 1940s by Swedish scientist Ulf von Euler. It is a neurotransmitter in the brain that significantly regulates arousal, attention, cognitive functions, and stress reactions. The noradrenergic system performs multiple roles within the central and peripheral neural systems. One of its primary functions is the body's "fight or flight" reaction. In response to stress or worry, norepinephrine and epinephrine are produced, binding to adrenergic receptors throughout the body. This results in pupil and bronchiole dilation, elevated heart rate, vasoconstriction, increased renin secretion from the kidneys, and inhibition of peristalsis. The noradrenergic system of the central nervous system traditionally enhances wakefulness, arousal, and sensory signal perception. Subsequent research indicates that it may also influence several cognitive and behavioral domains, including attention, working memory, long-term memory processing, and behavioral flexibility. The noradrenergic system is implicated in the etiology of significant neuropsychiatric illnesses and serves as a crucial therapeutic target in numerous psychiatric, neurological, and cardiovascular conditions (Neurotorium, 2022; National Library of Medicine, 2023).

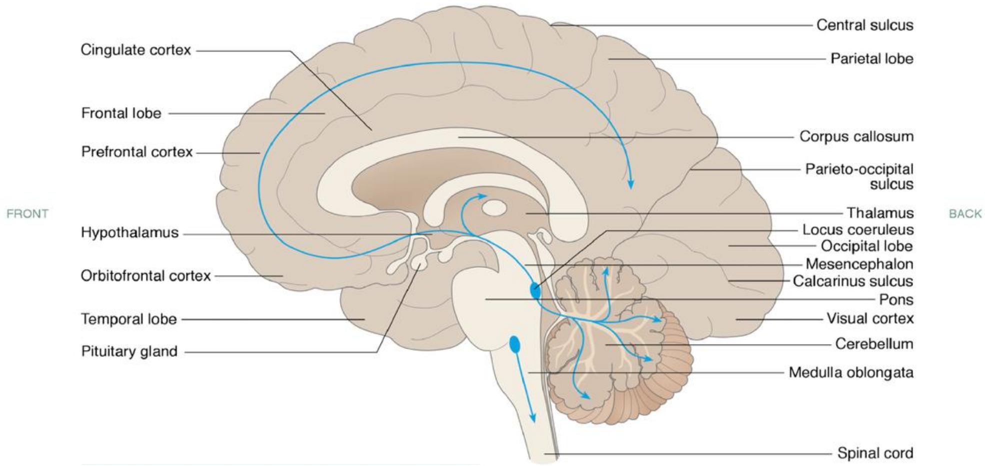

Figure 6 : Pathways of Norepinephrine (Neurotorium, 2022)

2.2.5. Reward System

The mesolimbic system, referred to as the reward system, comprises brain regions that govern the physiological and cognitive processing of rewards. Reward is an intrinsic process whereby the brain correlates diverse inputs (substances, situations, events, or activities) with favorable or desirable results. This results in behavioral modifications that ultimately compel the individual to pursue that particular favorable stimulus. Reward necessitates the synchronized release of several neurotransmitters. Dopamine plays a pivotal role among the neural substrates linked to reward. Dopamine is essential in regulating the reward value of food, beverages, sexual activity, social engagement, and substance dependence. The mesolimbic system, comprising the projections of dopamine neurons from the ventral tegmental area (VTA) to the striatum, prefrontal cortex, amygdala, hippocampus, and various other limbic areas, is the dopaminergic route most closely linked to reward. The activation of the dopaminergic mesolimbic system occurs upon the perception of rewarding stimuli, resulting in the release of dopamine into target nuclei. The ventral striatum, encompassing the nucleus accumbens (NAc), serves as the principal substrate for reward processing. The dorsal striatum is essential for action selection and commencement in decision-making and seems to govern feedback characteristics such as courage and magnitude, along with regulation of habitual behavior. Consequently, the dorsal and ventral areas cooperate in the facilitation of reward. Nonetheless, the NAc is esteemed primarily for its function in reward processing and its contribution to evaluative and incentive-based learning. Natural rewards, including nourishment, hydration, and reproduction, are essential for the survival and perpetuation of a species. The reward system fundamentally assesses the valence of a stimulus, indicating whether it should be avoided or approached, and prioritizes one stimulus over another. Substances of abuse, both illicit (e.g., cocaine, heroin) and licit (e.g., alcohol, nicotine), usurp the mesolimbic system by providing rewards devoid of a discernible biological purpose. Nonetheless, the gratification and satisfaction associated with first substance use diminish due to subsequent usage, resulting in a detrimental cycle of addiction (Lewis et al., 2021)

2.2.6. Stress System

Stress is characterized as the physiological and psychological reaction to internal or external stimuli that jeopardize an individual's balance. The central nervous system predominantly processes stress through the HPA axis, resulting in the release of glucocorticoids (such as cortisol in humans) and orchestrating adaptive responses to environmental challenges. Nonetheless, persistent or unmanageable stress can disrupt these systems, resulting in maladaptive behaviors and mental susceptibilities. The mesolimbic dopaminergic pathway, essential for reward processing, is one of the key systems in the brain influenced by stress. DA neurons from the VTA transmit to the nucleus NAc, prefrontal cortex, amygdala, and hippocampus, establishing the VTA-NAc loop that facilitates motivation, reinforcement learning, and emotional regulation. Acute stress generally increases dopaminergic activity in this system, promoting goal-oriented behavior. Nonetheless, prolonged exposure to stress significantly modifies this circuit (Baik, 2020). Acute stress elevates extracellular dopamine concentrations in the NAc and medial prefrontal cortex (mPFC), enhancing cognitive vigilance and adaptive behaviors (Holly and Miczek, 2016; Baik, 2020). This is generally facilitated by the phasic activation of VTA dopamine neurons in reaction to prominent stimuli. In contrast, persistent stress—especially when it is uncontrollable or unpredictable—can result in either hyperactivation or inhibition of dopaminergic activity, contingent upon the employed stress paradigm. Finally, stress influences not just the HPA axis and emotional centers such as the amygdala but also exerts significant regulatory control over dopaminergic pathways, particularly within the VTA-NAc circuitry. This reciprocal link indicates that stress and reward systems are closely interconnected, with stress-induced modulation of dopamine signaling potentially acting as both a risk factor and a therapeutic target in affect control, addiction, and mood disorders (Baik, 2020).

2.3. The Relationship between Belief and Mindset Change and Neuroplasticity, Reward and Stress Systems in Coaching

Professional coaching facilitates the transformation of an individual's self-perception and potential. This procedure frequently necessitates the individual to reorganize their entrenched belief systems, self-conceptions, and cognitive frameworks. The essence of the change lies in the individual's reformation of responses to inquiries such as “who am I?”, “what can I accomplish?”, and “how should I envision the future?”. This alteration is founded on both cognitive and neurobiological principles: neuroplasticity is a reconstruction process wherein brain-based mechanisms, including the reward and stress systems, are actively engaged (Grant, 2003; Doidge, 2007).

2.3.1. Neuroscientific Basis of Mindset Transformation

A mindset is a foundational framework that shapes the interpretations that individual assigns to learning, growth, and failure. Carol Dweck's (2006) delineations of fixed and growth mindsets elucidate how individuals react to external stimuli and evaluate their potential. The coaching process fosters a growth mentality, reframes mistakes as learning opportunities, and enhances self-efficacy perception (Grant, 2016). This cognitive restructuring is facilitated at the cortical level by the establishment of reconnections in regions such as the prefrontal cortex and anterior cingulate cortex (Doidge, 2007).

2.3.2. Cognitive and Emotional Recoding of Belief Systems

Belief systems are formed during childhood and function automatically, frequently without scrutiny. These beliefs are interconnected with concepts of self-esteem, capability, belongingness, and achievement. Incorporating potent inquiries, metaphors, value exploration, and future visions within the coaching process elucidates these beliefs, enabling their examination (David et al., 2014). The alteration in beliefs is elucidated by cognitive reframing and cognitive flexibility, wherein the individual cultivates alternate and more functional thought processes in lieu of automatic thoughts (Cozolino, 2017).

This approach necessitates the re-acquisition of emotional management skills. In stressful or unclear circumstances, previous reflexes are supplanted by more deliberate and selective responses. This neurobehavioral alteration is expedited particularly in coaching relationships characterized by stable attachment and guaranteed psychological safety (Siegel, 2010).

2.3.3. The Role of the Reward System (Dopamine): Neurochemical Motivator of Change

The coaching process facilitates modifications in the individual, such as "inner awareness," "visioning," and "creating new meaning," which stimulate the brain's reward system. The mesolimbic pathway,

Ventral Tegmental Area → Nucleus Accumbens → Prefrontal Cortex

which is stimulated by dopamine secretion, is specifically engaged (Robinson **and** Berridge **and**, 2003; Siegel 2010). This activation enhances the learning process, boosts motivation, and allows the individual to sustain goal-oriented activities. The internal motivation that arises in coaching is essential for both establishing a new objective and fostering commitment to that objective. The release of dopamine is linked to hope, anticipation, and a sensation of capability. The brain encodes the sensation of hope for a novel concept as a reward. Consequently, the "Aha!" moments that transpire during coaching conversations induce transformation on both a psychological and neurochemical level. The neurochemical pathways established during these instances guarantee that learning is retained permanently over the long term (Rock and Schwartz, 2006).

2.3.4. Role of the Stress System: Neurophysiological Barriers to Change

Conversely, challenging one's entrenched ideas may elicit a stress reaction, particularly when accompanied by a sense of loss of control, uncertainty, or perceived threat. The amygdala is triggered, resulting in an increase in norepinephrine release. Elevated norepinephrine may result in a constriction of attention, a decline in logical reasoning abilities, and a reversion to habitual behaviors (Arnsten, 2009).

Without the establishment of a secure relational dynamic in the coaching process, the individual's stress reaction may persist at elevated levels, so obstructing neuroplastic development. Nonetheless, when an individual exhibits emotional regulation and establishes relational trust, cortisol levels diminish, prefrontal brain functionality enhances, and the individual becomes more receptive to new information (Davidson and McEwen, 2012). This establishes an appropriate neurophysiological foundation for belief modification in coaching.

2.3.4. Practical Tools to Trigger Neuroplasticity in Coaching

Coaching stimulates neuroplasticity both directly and indirectly. Methods like visualization, positive affect exercises, reenactment, and re-narration of previous achievements enhance synaptic connections (Kolb and Whishaw, 2015). Repeated interviews particularly enhance the consolidation of these novel pathways. The efficacy of repetition is encapsulated in Hebb's renowned adage: “Neurons that fire together, connect together.” Moreover, methodologies that foster emotional resonance in coaching—such as empathic listening, emotional mirroring, and metaphorical narratives—enhance the neuroplasticity process, as emotionally charged events are retained in memory for extended periods (Siegel, 2010). Consequently, both knowledge and emotional awareness are essential for enduring transformation.

Ultimately, coaching seeks to foster enduring modifications in an individual's cognitive framework, emotional equilibrium, and behavioral tendencies. This shift is neuroscientifically facilitated by alterations in beliefs and mindsets, the motivating impacts of the reward system, management of the stress system, and neuroplastic restructuring. Consequently, coaching transcends mere communication; it constitutes a developmental domain whereby the brain undergoes restructuring and potential is neurobiologically activated.

2.4. Positive Affect and Negative Affect Schedule (PANAS)

Extensive research on the structure of affect has shown two predominant dimensions, leading to the proposal of many mood scales. Watson, Clark, and Tellegen (1988) developed the Positive Affect and Negative Affect Schedule (PANAS), a concise

Indicate the extent you have felt this way over the past week.		Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
PANAS 1	Interested	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 2	Distressed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 3	Excited	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 4	Upset	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 5	Strong	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 6	Guilty	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 7	Scared	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 8	Hostile	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 9	Enthusiastic	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 10	Proud	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 11	Irritable	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 12	Alert	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 13	Ashamed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 14	Inspired	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 15	Nervous	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 16	Determined	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 17	Attentive	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 18	Jittery	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 19	Active	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 20	Afraid	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Figure 7: Positive Affect and Negative Affect Schedule Orjinal version (Watson, Clark, and Tellegen ,1988)

and practical tool that offers reliable assessment through two mood scales comprising 10 items, addressing the shortcomings and low reliability of prior measures.

The components constituting the Positive Affect Score are items 1, 3, 5, 9, 10, 10, 12, 14, 16, 17, and 19. The scores may vary from 10 to 50, with elevated values indicating greater levels of positive affect.

The components constituting the Negative Affect Score are items 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20. The scores may vary from 10 to 50, with a lower number signifying a diminished amount of negative effect.

Gençöz (2000:19) performed a validity and reliability analysis for the Turkish adaptation of the 20-item Positive and Negative Affect Scale (Watson et al., 1988), utilizing data from 199 university students, with 10 items assessing positive emotions and 10 items assessing negative emotions. This study examined the validity and reliability of the PANAS, revealing considerable commonalities in mood components **between American and Turkish populations.**

Pozitif ve Negatif Duygu Durum Testi

		ÇOK AZ VEYA HİÇ	BİRAZ	ORTALAMA	OLDUKÇA	ÇOK FAZLA
1	İLGİLİ	☐	☐	☐	☐	☐
2	SIKINTILI	☐	☐	☐	☐	☐
3	HEYECANLI	☐	☐	☐	☐	☐
4	MUTSUZ	☐	☐	☐	☐	☐
5	GÜÇLÜ	☐	☐	☐	☐	☐
6	SUÇLU	☐	☐	☐	☐	☐
7	ÜRKMÜŞ	☐	☐	☐	☐	☐
8	DÜŞMANCA	☐	☐	☐	☐	☐
9	HEVESLİ	☐	☐	☐	☐	☐
10	GURURLU	☐	☐	☐	☐	☐
11	ASABİ	☐	☐	☐	☐	☐
12	UYANIK	☐	☐	☐	☐	☐
13	UTANMIŞ	☐	☐	☐	☐	☐
14	İLHAMLI	☐	☐	☐	☐	☐
15	SİNİRLİ	☐	☐	☐	☐	☐
16	KARARLI	☐	☐	☐	☐	☐
17	DİKKATLİ	☐	☐	☐	☐	☐
18	TEDİRGİN	☐	☐	☐	☐	☐
19	AKTİF	☐	☐	☐	☐	☐
20	KORKMUŞ	☐	☐	☐	☐	☐

Kaynak: Pozitif ve Negatif Duygu Ölçeği Geçerlilik ve Güvenilirlik Çalışması, Gençöz 2000

Figure 8: Positive Affect and Negative Affect Schedule Turkish version (Gençöz, 2000)

3. MATERIAL AND METHOD

3.1. Sort of the Research

This study is a non-pharmacological, observational, non-interventional and single-session clinical research. At the same time, it is an experimental study designed in a pre-test / post-test design to establish a causal relationship.

3.2. Model of the Research

The research is a quantitative model conducted in a single group, **pretest - posttest** design. Both hormonal measurements and psychometric evaluations were performed before and after the professional coaching session. Thus, the effect of coaching as an independent variable on hormone levels and mood as dependent variables was analyzed.

3.3. Location and Time/Date of the Research

The research was conducted at Uskudar University Institute of Health Sciences and biochemical analyzes were performed at Synlab Laboratories. Data collection was completed between **March 2025 and April 2025.**

3.4. The Universe and Sampling of the Research

The population of the study consisted of healthy adult individuals who had previously experienced professional coaching. The sample consisted of **15 volunteer participants, 10 women and 5 men, between the ages of 18-65,** who had previously received coaching services. The volunteers were selected from among adult individuals who had previously experienced coaching, reported that they had benefited from this process, and consented to the study.

Exclusion criteria included those who did not consent to the study, those under active psychiatric treatment, those with substance addiction, those under hormone therapy, and those with underlying chronic neurological diseases.

3.5. Data Assembling Tools

Two types of tools were used to collect data:

1. **Plasma Tests: Dopamine and norepinephrine levels** of the participants before and after coaching were measured by HPLC (High Performance Liquid Chromatography) method.

2. **PANAS (Positive and Negative Affect Schedule):** It was used to measure the changes in the participants' mood before and after coaching. The scale is a 20-item Likert-type scale consisting of 10 positive and 10 negative emotions.

3.6. Study Design and Methodology

The research flow chart is as follows:

1. Inclusion of individuals in the study and completion of the “Informed Voluntary Consent Form (Bilgilendirilmiş Gönüllü Olur Formu (BGOF)”.

2. First blood draw for hormone values before the coaching session

3. First application of the PANAS scale

4. Conducting the coaching session

5. Taking blood again for hormone values after the coaching session

6. Re-administration of the PANAS scale

Positive and Negative Affect Schedule (PANAS): This test was developed by Watson et al. in 1988. It was developed to measure positive and negative emotions with a total of 20 items, 10 of which are positive and 10 of which are negative. Each item is rated from 1 (very little or none) to 5 (very much). The Turkish validity and reliability study of the test was conducted by Tülin Gençöz in 2000. Factor validity was also performed.

3.7. Data Analysis

All statistical analyses were performed using **IBM SPSS** statistics (Windows version 28). Descriptive statistics were used to summarize the participants' baseline characteristics, including medians, and min-max for continuous variables and frequency distributions for categorical variables. P values were calculated using the **Chi square or Fisher's** exact tests for categorical variables and **Wilcoxon test** for continuous variables according to the normality assumption. **Spearman’s correlation** coefficient was calculated to asses the relationship between the variables. In all analyses, the level of significance was accepted as $p < 0.05$.

4. FINDINGS

4.1. Participants' Demographic Characteristics

A total of **15 healthy volunteers** participated in the study. Of these participants, **10 were female (66.7%)** and **5 were male (33.3%).** The **median age of the participants was 41 years** (Min-Max: 37-58).

4.2. Plasma Test Findings

Before the coaching session, the median plasma dopamine level was 29.03 ng/L (min-max: 20.94 - 35.80), **the median plasma norepinephrine level was 186.54 ng/L** (min-max: 147.18-217.42), **median plasma dopamine level was 29.53 ng/L** (min-max: 22.68 - 37.59) and **median plasma norepinephrine level was 185.30 ng/L** (min-max: 140.96 - 221.15) after the coaching session.

There was **no statistically significant difference in dopamine and norepinephrine levels before and after the coaching session** (p= 0.609, p=0.496, respectively).

4.3. PANAS Test Findings

Before the coaching session, the median PANAS test positive affect score was 34.00 (min-max: 25-42) and **the median PANAS test negative affect score was 15.00** (min-max: 10-37); **after the coaching session, the median PANAS test positive affect score was 45.00** (min-max: 27-50) and **the median PANAS test negative affect score was 11** (min-max: 10-22).

There was **a statistically significant difference in PANAS test positive affect and negative affect scores before and after the coaching session** (p= 0.002, p=0.006, respectively).

Plasma test findings and PANAS test findings are given in Table 1.

Table 1: PANAS Test Statistics with Plasma Test

	Before Coaching Session	After Coaching Session	p
Dopamine (ng/L) (min-max)	29,03 (20,94 - 35,80)	29,53 (22,68 - 37,59)	0,609
Norepinefrin (ng/L) (min-max)	186,54 (147,18 - 217,42)	185,3 (140,96 - 221,15)	0,496
PANAS Pozitive Affect Score (min-max)	34,00 (25 - 42)	45,00 (27 - 50)	0,002
PANAS Negative Affect Score (min-max)	15,00 (10 - 37)	11,00 (10 - 22)	0,006

4.4. Plasma Test – PANAS Correlation Findings

The decrease in negative affect in the PANAS test after the coaching session was **statistically significantly correlated with the increase in dopamine levels.** (r= -0,589, p: 0,021)

There was no statistically significant correlation between the positive affect score of the PANAS test and dopamine and norepinephrine (p: 0.393, p: 0.675, respectively).

The statistical correlation between plasma test and PANAS test is given in Table 2.

Table 2: Plasma Test and PANAS Test Correlation Statistics

		After Dopamine Results (N=15)	After Norepinephrine Results (N=15)
Positive PANAS Score	r	0,238	- 0,118
AFTER	p	0,393	0,675
Negative PANAS Score	r	-0,589	- 0,182
AFTER	p	0,021	0,515

N: Number of Participants

r: Correlation Coefficient

p: Sig. (2-tailed)

5.DISCUSSION

The main aim of this study was to examine the effect of professional coaching on the neurobiochemical processes and emotional states of individuals. The findings revealed significant changes, especially in affect levels, and changes in hormone levels such as dopamine and norepinephrine, which did not reach the level of significance, but supported the hypotheses in terms of relative direction. These findings point to the capacity of coaching processes to transform both psychological and physiological responses of the individual.

Relative Increase in Dopamine Levels: As we hypothesized, relative dopamine increased after the coaching session, although not statistically significant. Dopamine is at the center of the brain's reward system and is associated with motivation, learning, anticipation and goal-directed behavior (Schultz, 2015). In the coaching process, individuals' reviewing their life goals, setting meaningful goals and developing self-awareness may have created an intrinsic reward process that activated dopaminergic circuits. This result overlaps with the literature on the neurobiochemical basis of self-awareness, hope and self-efficacy. Being in a supportive interaction, especially in a social context, may activate the connections between the VTA and the prefrontal cortex (Berkman, 2018; Davidson and McEwen, 2012; Riddle, 2021). However, the lack of a statistically significant difference can be explained by the insufficient sample size and the fact that only one session was measured. Repetition, continuity and behavioral reinforcement are necessary to observe neuroplastic changes (Doidge, 2007; Draganski et al., 2004).

Relative Decrease in Norepinephrine Levels: As we hypothesized, relative norepinephrine decreased after the coaching session, although not statistically significant. Norepinephrine is a neurotransmitter directly related to threat perception, arousal and stress (McEwen, 2007). The fact that the participants were listened to without being judged, were in a supportive relationship and were able to express their thoughts during the coaching interview may have reduced the activation of the sympathetic nervous system. This may have led to a relative decrease in norepinephrine levels.

In particular, the environment of psychological trust in the coaching relationship may reduce the neurovegetative response to stress by calming the individual's amygdala-hypothalamus connection (Thayer et al, 2012). This finding suggests that coaching is effective not only on cognitive but also on biological stress regulation mechanisms.

PANAS Positive Affect Increase: PANAS positive affect increased statistically significantly after the coaching session. This increase clearly demonstrates the positive impact of positive psychology-based coaching practices on the emotional state of the individual. Individuals' gains in hope, commitment and self-awareness during the coaching process contributed to their experience of positive emotions (Green et al., 2006; Grant, 2003). According to Fredrickson's “Broaden-and-Build” theory, positive emotions expand an individual's cognitive resources and contribute to building new coping strategies (Fredrickson, 2001). The increase in positive affect in our study indicates that the coaching process supports the psychological resilience of the individual.

PANAS Negative Affect Decrease: PANAS negative affect decreased statistically significantly after the coaching session. One of the strongest findings of the study is that a statistically significant decrease in negative affect was observed. The coaching process improved competencies such as self-awareness and emotional regulation, enabling individuals to manage negative emotions such as stress, anxiety and guilt more effectively (Mejia, 2025).

This finding suggests that coaching not only supports goal-oriented behaviors, but also functions as a self-regulation tool that allows individuals to cope with internal conflicts in a healthier way.

Multiple Sessions and Neuroplasticity: The most important limitation of this study is that only one coaching session was evaluated. Neuroplasticity processes depend on time and repeated experiences (Doidge, 2007; Linden, 2006). Therefore, it is expected that multiple and prolonged coaching sessions would have more significant and statistically significant effects on both hormone levels and emotional responses.

In future research, generalizability can be increased by increasing the number of cases, including a wider age range and individuals with different professional backgrounds. Moreover, with more detailed coding of the content of the coaching process, it will be possible to study which technique or approach triggers which biochemical effects. Although no statistically significant difference was found for dopamine, it was thought that increasing the number of cases and multiple coaching sessions rather than a single coaching session would make this change more evident through neural plasticity.

6. RESULTS AND SUGGESTIONS

This study was conducted to examine the effects of a single coaching session on the neurobiochemical processes of an individual. It is of great importance to evaluate coaching practices, which have been growing rapidly in recent years and gaining more and more place in professional service areas, with scientific methods. In this direction, increasing the number of studies on the effects of coaching will contribute to the positioning of the practice not only as a popular personal development tool but also as a scientifically based intervention method. In this context, the present study aims to fill an important gap in the field and pave the way for more comprehensive research in the future.

The findings obtained within the scope of the research show that although the hormone levels did not reach statistical significance, relative changes occurred after the session. These changes indicate that the coaching process may have short-term biological effects on the individual. On the other hand, the data obtained through the Positive and Negative Affect Scale (PANAS) produced statistically significant results and revealed that positive changes were observed in the emotional state of the individual. These results provide preliminary evidence that coaching practices may have not only psychological but also physiological effects.

Considering the limitations of the study, one of the most striking factors is the sample size. To obtain qualified and generalizable results, it is of great importance to repeat similar studies with larger participant groups over a longer period. Moreover, structuring the coaching intervention in a long-term manner will make it possible to monitor not only immediate changes but also biological and psychological transformations that may become permanent over time. In this context, it is essential to conduct long-term studies in order to evaluate whether the mechanisms of neuroplasticity are activated.

It is foreseen that long-term coaching processes to be carried out in the future with more participants will enable coaching to be more accepted in academic circles through the scientific findings to be obtained. Such studies will make it possible to support the effects of coaching practices in areas such as self-awareness, emotion management, motivation, courage, stress management, ...etc. with more objective indicators.

As a suggestion, it is recommended that future biochemical analyses include not only dopamine and norepinephrine levels, but also other neurotransmitters such as oxytocin and serotonin, which are closely related to social attachment, happiness and emotion regulation. This approach would be useful in terms of revealing the multidimensional effects of the coaching process in a more comprehensive manner.

Furthermore, integrating neuroimaging techniques into such research will allow for the direct observation of possible changes in the structural and functional functioning of the brain. Methods such as Structural and Functional magnetic resonance imaging (MRI-fMRI) and electroencephalography (EEG) are effective tools that can be used to identify changes in neural activity that may occur as a result of the coaching process. The use of such techniques will make it possible to examine the effects of coaching on the individual's nervous system in more depth and to explain the contribution of coaching to neuroplasticity on a scientific basis.

In conclusion, this study provides preliminary findings on the potential neurobiochemical and psychological effects of coaching and provides a foundation for more comprehensive and methodologically sound research. Further interdisciplinary research is critical to increase the scientific validity and acceptance of coaching in clinical and organizational contexts.

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Appx. 3. Case Report Form

			Before PANAS Score																				Before	
Sequence No	Gender	Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Dopamine	Norepinefrin
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								

	After PANAS Score																				After	
Sequence No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Dopamine	Norepinefrin
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						
13																						
14																						
15																						

Appx. 4. PANAS (Positive and Negative Affect Schedule) – Original Version

Indicate the extent you have felt this way over the past week.		Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
PANAS 1	Interested	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 2	Distressed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 3	Excited	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 4	Upset	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 5	Strong	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 6	Guilty	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 7	Scared	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 8	Hostile	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 9	Enthusiastic	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 10	Proud	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 11	Irritable	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 12	Alert	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 13	Ashamed	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 14	Inspired	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 15	Nervous	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 16	Determined	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 17	Attentive	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 18	Jittery	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 19	Active	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PANAS 20	Afraid	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appx. 5. PANAS (Positive and Negative Affect Schedule) – Turkish Version

Pozitif ve Negatif Duygu Durum Testi

		ÇOK AZ VEYA HİÇ	BİRAZ	ORTALAMA	OLDUKÇA	ÇOK FAZLA
1	İLGİLİ	☐	☐	☐	☐	☐
2	SIKINTILI	☐	☐	☐	☐	☐
3	HEYECANLI	☐	☐	☐	☐	☐
4	MUTSUZ	☐	☐	☐	☐	☐
5	GÜÇLÜ	☐	☐	☐	☐	☐
6	SUÇLU	☐	☐	☐	☐	☐
7	ÜRKMÜŞ	☐	☐	☐	☐	☐
8	DÜŞMANCA	☐	☐	☐	☐	☐
9	HEVESLİ	☐	☐	☐	☐	☐
10	GURURLU	☐	☐	☐	☐	☐
11	ASABİ	☐	☐	☐	☐	☐
12	UYANIK	☐	☐	☐	☐	☐
13	UTANMIŞ	☐	☐	☐	☐	☐
14	İLHAMLI	☐	☐	☐	☐	☐
15	SİNİRLİ	☐	☐	☐	☐	☐
16	KARARLI	☐	☐	☐	☐	☐
17	DİKKATLİ	☐	☐	☐	☐	☐
18	TEDİRGİN	☐	☐	☐	☐	☐
19	AKTİF	☐	☐	☐	☐	☐
20	KORKMUŞ	☐	☐	☐	☐	☐

Kaynak: Pozitif ve Negatif Duygu Ölçeği Geçerlilik ve Güvenilirlik Çalışması, Gençöz 2000