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EDITORIAL MISSION STATEMENT
The editorial mission of the EWF – Scientific Magazine is to advance the knowledge of human movement based on the assumption that it is firstly, by any standard, the expression of muscular strength and secondly, a way of life and an ethical approach entrusted to professionals who not only are highly qualified, but also have full knowledge of the scientific facts, as well as being specifically competent. From its first issue, EWF – Scientific Magazine, has set itself the ambitious goal of bridging the gaps between the scientific laboratory and the operator on the field, enhancing both the practical experience of the coaches and the results of applied research. Consequently, the editorial rule will be a constant reference to practice and the publication of recommendations on how to apply the results of research to the practice of movement and sport.

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Interactions between HPA axis, sexual hormones, and fascia

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"We are all born with an innate impulse to play and enjoy ourselves, a need that is met when our caregivers play with us"
(Pat Ogden, Sensorimotor Psychotherapy, 2020)

EDITORIAL

THANK YOU ALL SO MUCH

Dear friends, dear readers, the issue you are about to read is the sixteenth, in chronological order. We started this journey exactly six years ago in April 2015, six important years during which this magazine has shown the world just how much science and knowledge revolve around the world of weight training and, in particular, weightlifting.

They have been years of great importance also for me, having had the privilege of being its editor. It was truly an extraordinary experience and for this reason, I want to thank the EWF Board who believed in this project from the word go, and in particular, all the authors who in contributing their articles and their research, have created a unique editorial project. And of course, a magazine would be nothing without its readers.

The EWF Scientific Magazine is currently the only magazine addressing the science of training in Olympic weightlifting and given that I often receive emails from all over the world, I have also had a great deal of positive feedback and the high regard in which it is held.

Unfortunately, in stark contrast to the success of this magazine, we are witnessing the constant and relentless decline of weightlifting as a sport. A decline that was perhaps predicted, but mainly by insiders and consequently, but mainly subtended by the insiders with the Control Bodies following close behind.

A single magazine is obviously not enough to provide all the cultural tools that such an ancient sport as weightlifting should already have in its DNA. Sad to say, our sport was lacking the cultural approach to ensure that today we could address the needs of these difficult times. Instead, we constantly witness the devastation caused by the excessive use of doping and, in other cases, we have also had to fight against corruption.

This sixteenth issue will be the last under my scientific leadership, I hope that future EWF executives will have include in their mindset and their programmes, the desire to continue investing in cultural projects regarding the vast world of training science.

There are difficult years ahead for international sport, because of many different factors: the current pandemic, the economic crisis, and the bad governance to which our beloved sport has been a slave for over 40 years.

We invite the younger generations of athletes and coaches who are taking their first steps in this Olympic world of weightlifting, to be wary of the older generations, many are the offspring of gurus without any culture and very often, without any scruples. However, there are also so many extraordinary people and it is with them that you must find a new path for the rebirth of this sport.

I have been honoured to have led the EWF for 17 years but even more honoured to have learned so much culture and knowledge from many of you, my friends.

Till we meet again!

Antonio Urso
EWF President

The official journal of the European Weightlifting Federation

IMPACT OF STRESS, IMMUNITY, AND SIGNALS FROM ENDOCRINE AND NERVOUS SYSTEM ON FASCIA

[Frontiers in Bioscience, Elite, 13, 1-36, Jan 1, 2021]
Impact of stress, immunity, and signals from endocrine and nervous system on fascia.

ABSTRACT

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INTRODUCTION

The hypothalamic-pituitary-adrenal (HPA) axis and the stress response are paramount for the organism to cope with physical threats or psychosocial adversities. Extensive knowledge has been gained on how:

1. the stress response can affect every endocrine axis (1–3);
2. many cells of several tissues can produce and secrete stress hormones (and also catecholamines) that can impact the central HPA axis and the whole body (4–6);
3. the HPA axis can heavily influence the immune system (7, 8);
4. the stress response can affect the body structure (9, 10).

Fascia is a particular kind of connective tissue – different from blood, cartilage, and bones – having a ubiquitous, multi-functional nature: it provides the structural and functional architecture of the body.

The fascia integrates the functions of several systems (e.g., the nervous, immune, and cardiovascular systems) and can transmit mechanical, chemical, and electrical information (11–13). The fascia has no universally accepted definition of it (13), but since defining fascia is not our purpose, we refer the reader to the appropriate references (14, 15).

For the sake of simplicity, we will consider the terms "fascia" and "fascial system" according to the definition given by Carla Stecco and Robert Schleip in an editorial about fascia science and its clinical applications: a fascia is "*a sheath, a sheet or any number of other dissectible aggregations of connective tissue that forms beneath the skin to attach, enclose, separate muscles and other internal organs,*" whereas the fascial system is "*a network of interacting, interrelated, interdependent (fascial) tissues forming a complex whole, all collaborating to perform a movement.*"

This definition of "fascia" can be useful to describe anatomical features, whereas the term "fascial system" may prove helpful to manual therapists in explaining what occurs during a manual therapy session (16).

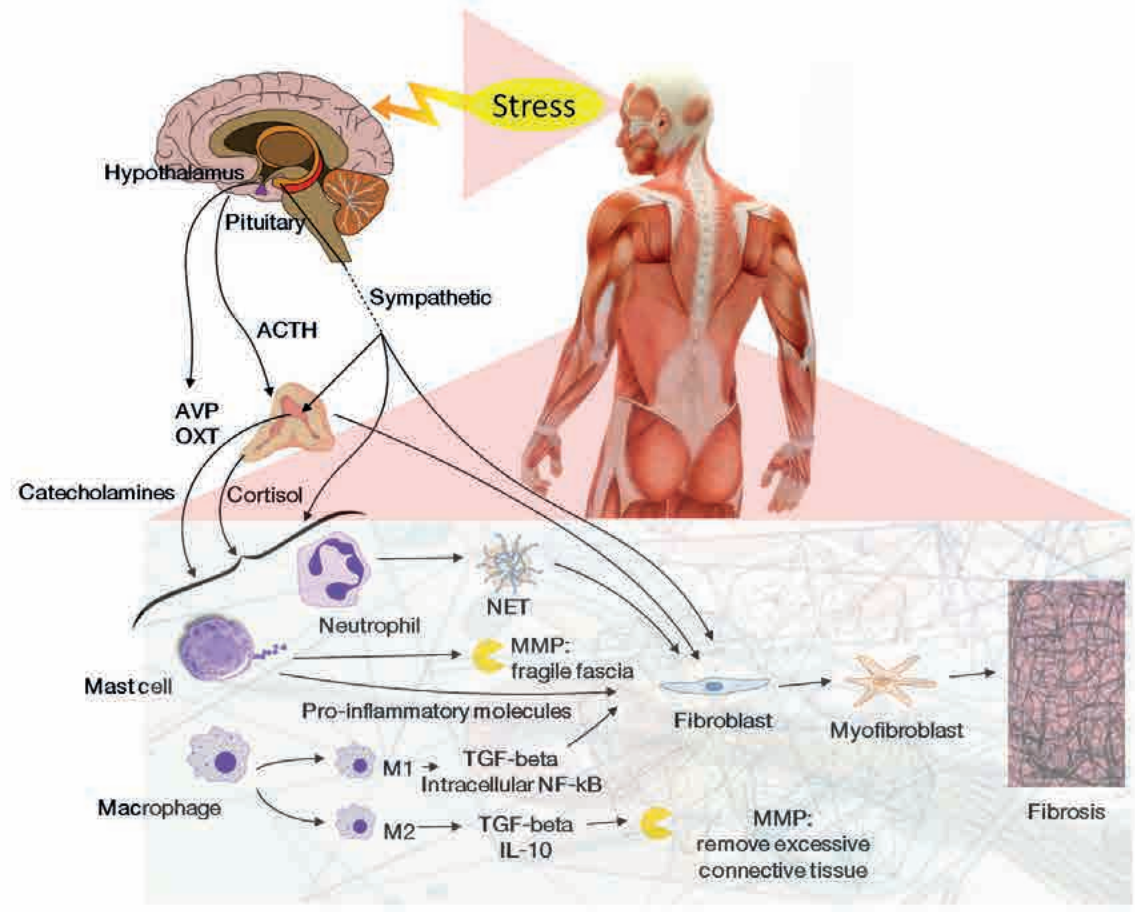


FIGURE 1: The relationship between stress axis, immune system, and fascia: the activation of the HPA axis stimulates the adrenals to release catecholamines and cortisol. These hormones, together with the activation of the sympathetic nervous system caused by stress, stimulate immune cells inside the fascia. Based on the intensity of the stimulus, macrophages, mast cells, and neutrophils release molecules that can influence the structure of the fascia.

Although the stress response can alter the fascia and related tissues (10), it seems no previous research has focused on describing the relationship between the stress response and fascia. On June 13, 2020, for instance, only four studies were retrieved from the PubMed database with the search string 'fascia AND ("stress response" OR "HPA axis" OR "stress axis" OR "hypothalamic-pituitary-adrenal axis").' Only one of these papers briefly discusses the relationship between HPA axis hyperactivity and fascial dysfunction in the case of fibromyalgia (17). Considering the attention paid to the fascia by many manual therapists, we think it is paramount to show how the stress response, fascia, and the immune system can interact.

By understanding the physio-pathological relations between stress, immunity, and fascia, it is possible to better comprehend the interaction between body functions (e.g., circulation, immunity, and neuro-hormonal regulation) and structures (e.g., fascial system, muscles, and bones). Recent advancements in various fields – including medicine, psychology, sociology, biology, mechano-biology, and sychoneuroendocrineimmunology (PNEI), which studies the interactions between mind, body, and environment in determining health or disease (1, 18) – have also recognized that chronic pathologies can benefit from a therapeutic approach that takes into account:

- the patient's lifestyle – emotions, diet, and physical activity can affect many diseases (19–22);
- the systemic influences of every organ – e.g., the vicious cycle connecting dysbiosis, arthritis, low back pain, and Parkinson (23, 24);
- the benefits of both pharmacological and non-pharmacological therapies (18) – clinicians should cure disease, but also preserve and promote health.

While non-pharmacological therapies like manual and movement therapies (e.g., massage, osteopathic manipulative treatment, and shiatsu, breathing exercises, Taiji Quan, and Qigong) have been proven beneficial in preserving, promoting, and restoring health (25–28), they still lack a strong rationale (29–31). Manual and movement therapists require a better comprehension of how the body can be influenced by the stress response and immune system. Otherwise, they may lack a good grasp of these therapies' potentialities and limitations and look to the patient's pain only in mechanical terms.

Therefore, the present paper aims to describe (i) the stress response main features and influence on the immune system; (ii) the fascia as connective tissue, explaining the behavior of fibroblasts and myofibroblasts (32); (iii) the main interactions between stress, immunity, and fascia (Figure 1).

THE STRESS RESPONSE: AN UPDATED EXPLANATION

The human HPA axis is mainly activated by psychosocial stimuli (37), which can dramatically affect the HPA axis and other related neuroendocrine responses via numerous molecules produced by the brain, with a heavy impact on health and longevity (19, 38–40).

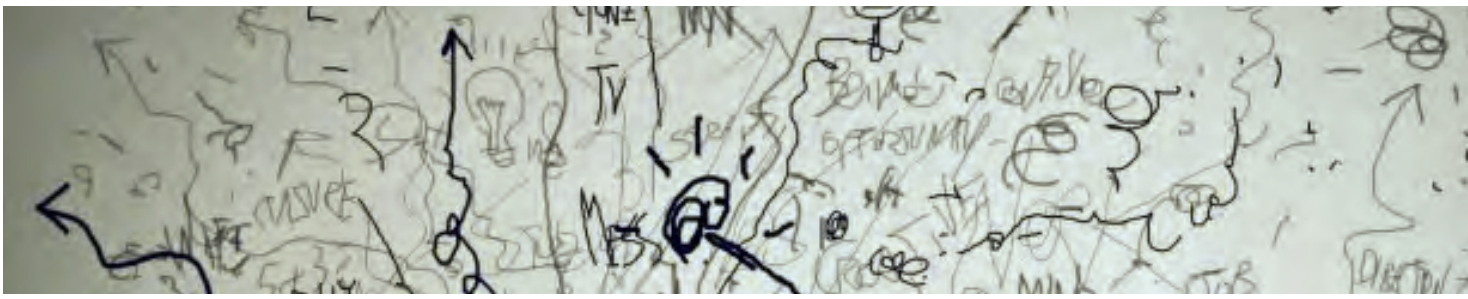
The stress control room: the hypothalamus

The hypothalamus commands the endocrine system and releases many neurotransmitters that circulate throughout the brain and the body. Its activity can be summarized as follows (35):

1. it secretes arginine vasopressin (AVP) and oxytocin (OXT). These two hormones mainly target the kidneys (41), the brain, the uterus during pregnancy and mammary glands after labor (42);

2. it secretes hormones regulating the anterior pituitary. This part of the hypophysis then releases specific hormones to regulate the activity of gonads, uterus, adrenal cortex, liver, bones, and thyroid (43);

3. it secretes hormones and stimulates the sympathetic nervous system (SNS) to control adrenal medulla, pancreas (44), and pineal gland (45).



The three branches of the stress response

The stress response originates from the paraventricular nucleus (PVN) and involves several neuroendocrine circuits. The three main branches of the stress response are (35):

1. the HPA axis. It originates from the PVN parvocellular nuclei that release CRH, thus inducing the hypophysis to secrete ACTH (35, 46), which in turn stimulates the adrenal cortex to secrete cortisol. The parvocellular nuclei receive information about (i) the body from the nucleus of the solitary tract and the circumventricular organs; (ii) the emotional and affective states from limbic areas such as amygdalae (47), nociceptive centers, and other cortical areas (48);
2. the hypothalamic-SNS-adrenal medulla axis. It originates from the PVN projection neurons that send information to the brainstem, in particular to the locus coeruleus and the rostral ventromedial medulla (RVM). While the locus coeruleus represents the main noradrenergic center of the brain, the RVM nuclei control the SNS (49). The adrenal medulla can also be activated by several motor areas (premotor cortex, primary motor cortex, supplementary motor area, rostral and caudal areas of cingulate cortex), the medial prefrontal cortices (ventromedial orbitofrontal cortex), and the anterior cingulate cortex (pregenual and subgenual). All these areas are connected to the amygdalae and the hypothalamus and use the corticospinal pathway to transmit information from the brain to the organism (50). This information arrives in the chromaffin cells of the adrenal medulla and stimulates them to secrete adrenaline, noradrenaline, and a small amount of dopamine (43). This direct pathway between cerebral motor areas and the adrenal medullae allows stressors to immediately alert the muscular system (50);
3. the hypothalamic-posterior pituitary axis. It originates from the PVN magnocellular nuclei that receive information about the body fluids status, including blood volume, and can release AVP and OXT to regulate blood pressure, blood volume, and hydration (35).

These three axes are regulated by negative feedback: the hypothalamus and hypophysis monitor cortisol and catecholamines plasma levels via mineralocorticoids and glucocorticoids receptors (GR) (35).

The systemic effects of stress hormones

Thorough knowledge of the effects of stress hormones is necessary to understand their impact on the body structure:

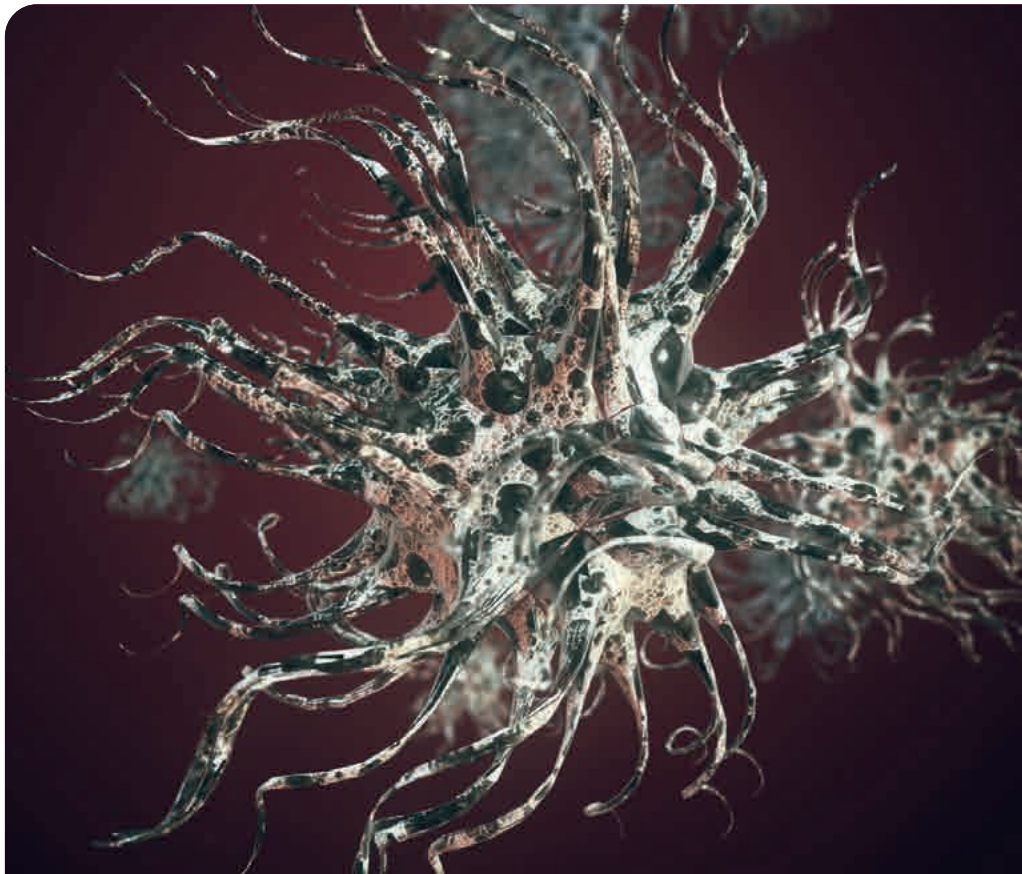
1. CRH is correlated with anxiety and motor hyperactivity. CRH can inhibit the activity of other hypothalamic hormones, i.e., TRH, increasing hypothyroidism risk; gonadotropin-releasing hormone, facilitating reproductive disorders; and growth hormone-releasing hormone, promoting growth problems in children living under high stress (43). CRH is also produced by immune cells and the autonomic nervous system (ANS). CRH has a pro-inflammatory effect, stimulating mast cells in many tissues and organs such as the gut, brain, respiratory mucosa, prostate, vagina, uterus, heart, and even fascia (51);
2. ACTH induces the adrenal cortex to produce cortisol, dehydroepiandrosterone, and aldosterone. ACTH can also stimulate adipocytes to produce interleukin-6 (IL-6), thus favoring insulin-resistance under chronic stress (52);
3. cortisol, the primary hormone released by the HPA axis. During acute stress, cortisol prepares an individual to respond to cognitive or physical stressors: it raises awareness and mobilizes energetic and muscular resources. Under chronic stress, cortisol produces several effects: (i) the dendrites in the hypothalamic and medial prefrontal cortex decrease (35) while they increase in the amygdalae – this neuronal reorganization depends on reversible epigenetic mechanisms (53); (ii) arousal of particular pro-inflammatory immune circuits (54); (iii) cardiovascular system stress, with increased risk of heart diseases (55); (iv) alteration of the circulating lipids, impacting the function of the metabolic system (56); (v) restriction of blood flow to stomach mucosa, favoring gastric ulcers (57); (vi) possible fibrosis and steatosis in the liver (58); (vii) increased risk of ocular pathologies such as glaucoma (59). Furthermore, cortisol affects bones, muscles, and fascia (9);

4. OXT raises during social interactions with positive effects on mood and represents the hormone of love and empathy – it helps social bonding in many kinds of relationships, such as family and friendship. It can be detected in abundance in the superior temporal sulcus and the fusiform gyrus: the former is involved in cognitive tasks, and the latter in emotion recognition from facial expression. OXT stimulates uterine muscle contraction to induce labor and regulates gamma-aminobutyric acid level to allow the brain development of newborns (35, 60);
5. AVP affects blood pressure and the metabolism of body fluids, and activates the HPA axis together with CRH (35, 61);
6. adrenaline, secreted by the adrenal medulla, is the chemical mediator of the adrenergic nervous pathways. It accelerates heart rate, increases blood pressure, dilates coronaries, elicits myocardium activity, induces vasoconstriction, stimulates liver glycogenolysis, raises glycemia, inhibits bronchial and intestinal muscles activity and has a local hemostatic and ischemia-inducing action. Adrenaline acts in particular on alpha and beta-2 receptors (62);
7. noradrenaline acts on the postganglionic sympathetic nerves and causing intense vasoconstriction accompanied by a rise in diastolic pressure (62). It is stored in large quantities in secondary lymphoid organs, in lymphoid tissues associated with mucosa, gut, and bronchus, and in the spleen, where the two ANS branches merge to create several integrated reflexes necessary to regulate systemic inflammation and immune response (63, 64).

The immune system and its relationship with the stress response

To better understand the effects of the stress response on immunity, we provide a short description of the four main immune subsystems (65). This classification is, however, more conceptual than real since white cells can shift their phenotype depending on external stimuli (e.g., cytokines) and simultaneously express characteristics of two different immune subsystems (65, 66). The four main immune subsystems are:

1. type-1 immunity protects the organism from viruses and neoplastic cells but also produces major pro-inflammatory effects and can lead to the development of autoimmune pathologies, including type 1 diabetes and multiple sclerosis. The type-1 immunity phagocytes clean up dying cells and debris and release free radicals and enzymes to destroy pathogens, kill infected cells, ingest dying cells and extracellular matrix (ECM). This subsystem also includes type-1 and type-3 innate lymphoid cells (ILCs), which allow tissues to repair and recover their physiological characteristics. Due to its highly inflammatory nature, type-1 immunity acts in conjunction with type-2 immunity, which is typically anti-inflammatory, to achieve optimum tissue repair (67);
2. type-2 immunity protects the organism from extracellular parasites, venoms, toxins, and can be elicited by antigens. This subsystem is located primarily in the gut, respiratory apparatus, and reproductive organs mucosa, where it controls eosinophils and immunoglobulins recruitment (68).



Excess activity of this subsystem can lead to allergic responses (e.g., asthma and dermatitis) (68) and autoimmune pathologies characterized by antibodies production (e.g., lupus). It can also worsen neoplastic disease if present. Type-2 immunity cells, including tissue-resident type-2 ILCs (69), secrete cytokines that regulate processes such as tissue repair, metabolic and temperature control (65, 70). Type-2 immunity acts against organisms too big to be ingested by a single cell (71), whose elimination needs large tissue remodeling. Since they can heavily reshape tissues, type-2 immune cells and cytokines can induce organic fibrosis: under chronic inflammation, they elicit fibroblast activation, myofibroblast differentiation, and ECM secretion and lay down (67);

3. type-3 immunity acts on extracellular microbes and fungi, regulating the microbiota (72). It protects tissues from damages – by reinforcing the epithelial barriers and making them resistant to microbial activity – but can induce the high inflammation characterizing chronic autoimmune pathologies (e.g., rheumatoid arthritis and psoriasis) (67);
4. regulatory immunity acts via regulatory lymphocytes – they can show different phenotypes depending on the tissue and its health – to monitor the other types of immunity and control inflammation. Regulatory immunity prevents autoimmune and allergic pathologies by reducing inflammation and protects from infections and tumors by enhancing inflammation. This type of immunity can also affect neuroendocrine transmission (66, 73–75).

Many immune cells, such as natural killers (NKs), macrophages, and ILC-1, express glucocorticoid receptors on their cellular membrane to coordinate their action locally and through the reception of systemic signals (67). Many immune cells, from mast cells to naive Th0 lymphocytes, also express catecholamine receptors (e.g., alpha-2 and beta-2 adrenergic receptors) to sense signals deriving from the nervous branch of the stress response (63). Therefore, through releasing glucocorticoids in the bloodstream, the neuroendocrine system can regulate inflammation strength and duration and protect the organism.

Under acute stress, catecholamines induce immune cells to move into tissues (76) and specialize: Th0 naive cells may become Th1 (type-1 immunity), Th2 (type-2 immunity), Th17 (type-3 immunity), or T regulatory cells. B and T lymphocytes, antibodies, and NKs increase to mount an adequate response: type-1 to contrast viruses, intracellular microbes, and neoplasms; type-2 to contrast parasites and toxins; type-3 to contrast extracellular microbes and fungi (63). Catecholamines and cortisol show, instead, an anti-inflammatory action on already differentiated lymphocytes (8, 63).

Under chronic stress, the situation is far more complex (8, 63, 77):

1. cortisol and catecholamines dampen type-1 immunity and bolster type-2 immunity, thus reducing the ability to fight against viruses and neoplasms. Type-2 and regulatory cytokines such as interleukin-13 (IL-13) and transforming growth factor-beta (TGF-beta) shift from anti-inflammatory to pro-inflammatory and can elicit tissue texture alterations (e.g., demyelination) and fibrosis (the TGF-fibrosis link is discussed in sections 5 and 6). Since type-2 immunity recruits and activates eosinophils, basophils, mast cells, and IgE, allergic responses can manifest (65, 66, 75, 78);
2. the chronic SNS activation can induce the down-regulation of beta2-adrenergic receptors, which favors the hyper-production of inflammatory cytokines such as TGF-beta, and the hypo-activation of the parasympathetic nervous system, which then fails to activate the anti-inflammatory splenic ANS reflexes (79). The HPA axis hyper-activation can make lymphocytes glucocorticoid-resistant due to the high level of circulating glucocorticoids – cortisol loses the ability to suppress type-1 immunity and inflammation, thus facilitating autoimmune diseases (3).

THE CONNECTIVE TISSUE

ECM structure and function

ECM allows connective tissue to perform its various functions: organ shaping, support, protection, communication, etc. Since every cell resides inside the ECM, the form and function of every cell depend on the ECM (80).

The main ECM constituent is procollagen, which becomes collagen after several post-translational enzymatic reactions. Collagen is a protein formed by a triple helix of polypeptides, each constituted by the alternation of three amino acids: glycine, proline, or lysine (81). Collagen formation needs the reaction of glycosylation, which attaches a carbohydrate to the side chain of its constituent amino acids. If an excess of glycosylation occurs, the structure of collagen may become unable to perform its functions (81): both connective tissue and bones may thus be affected, losing elasticity and robustness. This phenomenon may occur in the presence of hyperglycemia: the quantity of carbohydrates circulating in the bloodstream and tissues is so high that glycosylation starts spontaneously, without the intervention of enzymes. This process is called "glycation" and causes the formation of "advanced glycation end-products" (AGEs), which can accelerate aging and degenerative processes (82). AGEs can build up in connective and fascial tissues and cause both inflammation and structural and functional disorders – collagen turnover seems rather slow, showing a half-life of 4-12 months in the liver but of 215 years in the intervertebral discs of an elderly man (83, 84).

Collagen makes up about 30% of the whole-body protein content and can be classified in more than 28 types of different fibers (81). Since every fiber has different characteristics, the collagen composition of the ECM changes according to the stress, especially mechanical, it undergoes. For example, tendons, menisci, and the annulus fibrosus of the intervertebral discs are formed by type I collagen, which is very well suited to resist traction, whereas articular cartilages and the nucleus pulposus are formed by type II collagen, which is very proficient in resisting compression (85–87). Mechanical stress enables the differentiation of connective tissue at any age, and different combinations of compressive and tensional forces induce the formation of different collagen fibers so that connective tissue can better adapt to everyday mechanical stimuli. Therefore, physicians, physical therapists, and manual therapists like osteopaths and chiropractors should comprehend the biomechanical role and function of every collagenic structure, so as to properly choose the optimal kind of force to elicit a good structural and functional recovery (85–87).

ECM also contains elastic and reticular fibers. Reticular fibers constitute the stroma of hematopoietic and lymphoid tissues (thymus excluded), but they are replaced by stronger collagen fibers in the case of wounds (80, 88). Elastic fibers form the ECM of various tissues, such as smooth muscles, especially the vascular ones – elastic fibers constitute 50% of a blood vessel –, lung epithelium, skin, elastic cartilages, and even some tendons and ligaments (about 2-5% of their mass) (80, 81, 89).

ECM is also made of ground substance, an amorphous, aqueous, and viscous gel-like substance rich of long molecular chains: glycosaminoglycans (GAGs), proteoglycans, and multi-adhesive glycoproteins (80).

These molecules intertwine with collagen fibers, several proteins located in the cellular membrane such as integrins, and the cytoskeleton to create a reticular structure that shapes and protects the cells it surrounds. This complex structure allows the exchange of substances and the communication between cells, relying upon integrins because of their particular sensitivity to mechanical stimuli: integrins can transduce external mechanical forces in intracellular biochemical signals that can alter gene expressions – therefore, mechanical stimuli can induce epigenetic effects (89).

Proteoglycans and GAGs can absorb compressive shock in tissues such as cartilages and intervertebral discs, protecting the body from sudden or excessive mechanical stress. When proteoglycans link to the water attracted by GAGs, the connective tissue becomes viscoelastic and the collagen fibers can efficiently slide on one another.

GAGs and proteoglycans that contain hyaluronic acid prevent undesired movement of substances among tissues: indeed, molecules such as growth factors must be confined within the specific tissue that needs them. They also prevent the infiltration of microbes or neoplastic cells, which have thus to catabolize the ECM to get through the connective tissue (81, 89).

At last, ECM contains multi-adhesive glycoproteins (e.g., fibronectin and laminin) that link all the other fibers and interact with integrins and laminin receptors, thus stabilizing the ECM. Multi-adhesive glycoproteins can convey mechanical forces through the ECM to the cytoskeleton (89) and receive a direct stimulation during physical activity and manual therapies – these mechanical stimuli affect the synthesis of these proteins and collagen (90, 91).

All ECM components are equally important for a healthy connective tissue: given the role of the ECM at the structural, nutritive, and immune level, any disorder affecting one of its components can have serious consequences for the organism (92). In particular, in recent years, mechano-biology has shown that the ECM tensional status has a significant impact on cellular differentiation and proliferation. For example, a mesenchymal stem cell can become a neuron, an adipocyte, a skeletal myocyte, an osteocyte, or another kind of cell depending on ECM rigidity: a low ECM rigidity (low mechanical tension) brings about a neuron, while a high rigidity (high mechanical tension) an osteocyte (93).

Besides, recent studies have discovered that many physiological functions depend upon the mechanical dimension. For instance, sleep and fever stimulate immune response via mechano-sensitive proteins: fever elicits the expression of heat shock proteins on lymphocytes to make them link with other cells' integrins (94), whereas sleep prevents the accumulation of Ga_s-coupled receptor agonists, immunosuppressive proteins that block lymphocytes integrins (95).

The fibroblasts

Fibroblasts are highly heterogeneous and show different secretory capabilities: some fibroblasts produce only type I collagen, while others only type III collagen (96). They are fusiform and flat cells, lacking a basal membrane and equipped with several processes, one or two nuclei, prominent rough endoplasmic reticulum, and Golgi apparatus. Their cytoskeleton displays an abundance of intermediate filaments mainly constituted of vimentin, actin, and myosin, which allows them good motility (97, 98). Fibroblasts that reside in different organs can be very dissimilar: fibroblasts found in the heart (97–99) differ from those in the lung (100, 101), peritoneum (102), and elsewhere (99).

Each fibroblast promptly responds to various inputs, either mechanical (e.g., compressive and tensional forces or shear stress due to fluid flow) or chemical (e.g., cytokines, hormones, or hypoxia), thereby influencing the behavior of adjacent cells (100). In the presence of chronic inflammation or repeated wounds, all fibroblasts can promote fibrosis since they are able to secrete a high amount of collagen and substances, including vascular cell adhesion molecules and intercellular adhesion molecules, that tie to leukocytes and increase inflammation (100). As an exception, oral fibroblasts cannot induce fibrosis nor scar tissue: they are similar to fetal fibroblasts, which secrete the highest amount of anti-inflammatory cytokines as compared to all the others (103).

When the organism needs to produce more ECM, for instance during growth or wound repair, fibroblasts increase their cytoplasm to develop larger rough endoplasmic reticulum (protein synthesis) and Golgi apparatus (vesicular transport). As a consequence, they become "activated fibroblasts": they secrete a larger amount of proteins, GAGs, and procollagen, in particular for the formation of type I and III collagen. Activated fibroblasts also produce fibronectin, periostin, metalloproteinases (MMPs), and pro-inflammatory cytokines such as IL-6, TNF-alpha, TGF-beta, and endothelin-1, which have a local autocrine or paracrine action. In remodeling the ECM, fibroblasts are aided by various other cells, such as myocytes and endothelial cells, and especially by immune cells: neutrophils, macrophages, and mast cells (80, 90).

Leukocytes produce functional proteins such as MMPs, growth factors and cytokines, whereas fibroblasts, myocytes, and endothelial cells secrete mainly ECM structural proteins (90). Conversely, the ECM and the proteins dispersed in it condition the phenotype and activity of fibroblasts. For example, a glycated ground substance due to hyperglycemia increases fibroblasts apoptosis and reduces their ability to proliferate and migrate. It cuts the synthesis of collagen, MMP-1, MMP-2, and hyaluronic acid and slows both angiogenesis and immune cells recruitment – this undermines healing (96).

Fibroblast activity is also affected by extracellular pH: if it falls below 6.7, as in case of neoplasms or ischemia, the circadian cycle of fibroblast becomes accelerated – they start living days of 22 hours (104), which makes

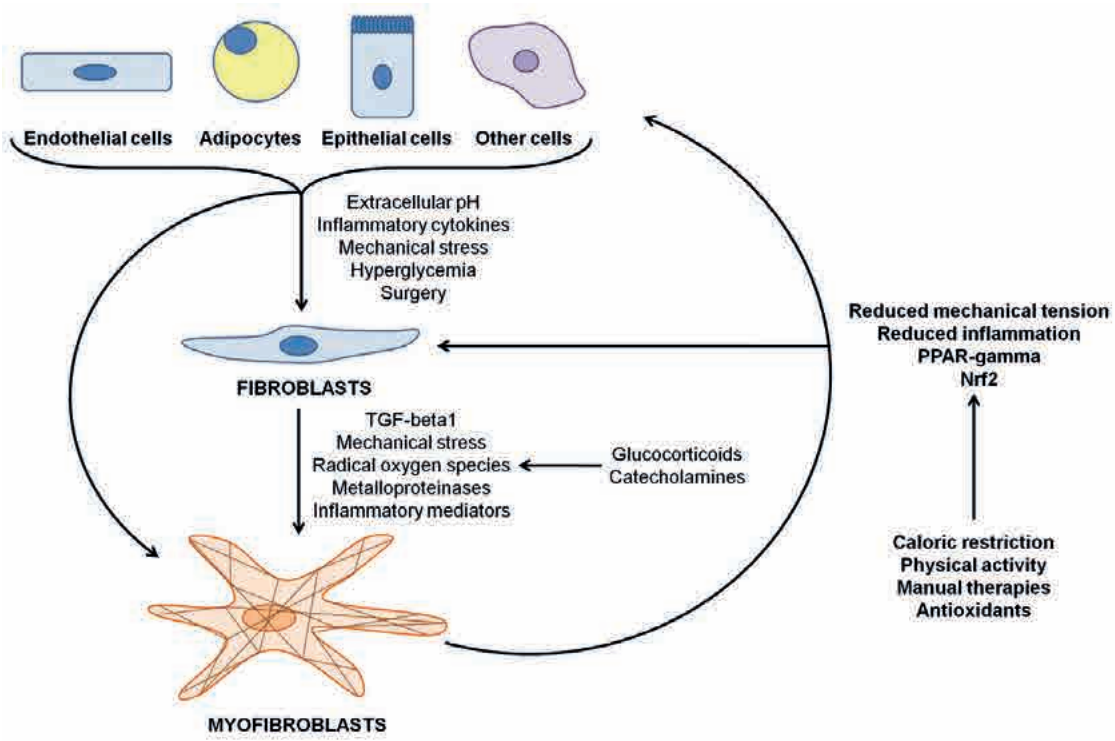


FIGURE 2: Cells can change their phenotypes when stimulated. Endothelial, epithelial, and mesenchymal cells can become fibroblasts due to the effect of inflammatory cytokines, mechanical stress, and extracellular pH; other stimuli such as hyperglycemia and surgery can also induce this phenotype shift since they increase inflammation and mechanical stress. These same stimuli – in particular, TGF-beta1, mechanical stress, and ROS – can elicit fibroblasts and many cells to become myofibroblasts: they can produce contraction since they show a high concentration of alpha-SMA fibers. Fibroblasts and myofibroblasts appear when the organism needs to increase the production of extracellular matrix and to heal a wound: psychophysical stress can facilitate the induction of these cells through the secretion of cortisol and catecholamines, which can increase inflammatory cytokines and ROS. Myofibroblasts can de-differentiate back into their original phenotype through interventions that can reduce the mechanical stress and the inflammation level, or that can activate factors such as PPAR-gamma and Nrf2: some example are caloric restriction, physical activity, manual therapies, and antioxidants.

them more susceptible to endogenous and exogenous toxins and more prone to induce inflammation (105). Moreover, extracellular acidity can increase the activity of proteases (e.g., MMPs) that can remodel connective tissue during acute stress but induce inflammation and tissue destruction in the long run.

Acidity can also bring about deformed, elongated cells, facilitate the activation of integrins, elicit cellular adhesion (e.g., between endothelium and neutrophils) and slow cellular migration rate (106). Large changes in extracellular pH, whether towards acidosis or alkalosis, strongly reduce GAGs secretion (107) and modify several cells such as pericytes (contractile cells located inside blood vessel walls), adipocytes, endothelial, and epithelial cells, transforming them into fibroblasts via the phenomenon known as epithelial-mesenchymal transition (EMT) (96) (Figure 2).

EMT can be both a physiological (e.g., wound healing) or a pathological process (e.g., fibrosis and neoplasms), and it is facilitated by pro-inflammatory molecules such as NF-kappaB and TGF-beta – TGF-beta strongly induces fibroblast activation and fibrosis (108, 109) – and under conditions such as hyperglycemia and surgical interventions (102). The cells transformed via EMT, however, may return to their original state once the stressor who induced EMT passed (96).

Among the cells that appear through EMT, we can find the myofibroblasts (110) (Figure 2).

The myofibroblasts

Myofibroblasts derive from fibroblasts that developed a cytoskeleton similar to that of myocytes and can be induced by mechanical stress, cytokines, and other stimuli. Myofibroblasts express fibers of alpha-smooth muscle actin (alpha-SMA) similar to those of myocytes, which allow them to produce strong cellular and tissue contractions, which compact collagen and ground substance every time new ECM is secreted (98, 99). These contractions put myofibroblasts in a pre-stress status to better react to internal or external mechanical stimuli (by comparison, the sound produced by a violin depends on the tightness of its strings). When myofibroblasts are in a pre-stress status, also the fascia is in a pre-stress status (111, 112).

Fibroblasts at rest possess actin and myosin filaments, but can't create cell-cell or cell-ECM adhesions and sustain a high mechanical load: the ECM protects them from excessive mechanical stress (108, 113). Under mechanical or chemical stress, fibroblasts start producing beta-/gamma-cytoplasmic actin filaments and fibronectin and acquire the capability to create focal adhesions, a particular kind of cell junction, and to link with the ECM – proto-myofibroblasts are born (108, 110, 113, 114). If this stimulation continues, as in the case of tissue lesions or chronic inflammation, integrins located in the cellular membrane of proto-myofibroblasts induce the release of TGF-beta1 from the large latent complex (LLC). Proteolytic enzymes such as MMPs, plasmin, thrombin, and elastase can also free TGF-beta1 by "digesting" LLC (115, 116).

TGF-beta1 is usually an anti-inflammatory cytokine similar to IL-10, but it can induce a type-3 immune response, high inflammation, and fibrosis (117) – TGF-beta1 seems the major stimulus for myofibroblasts to differentiate and produce contractions (118, 119). TGF-beta1 increases the secretion of tissue inhibitors of metalloproteinases, which raise connective tissue mechanical tension (110), and induces proto-myofibroblasts to produce alpha-SMA (114) and to create very strong cell-ECM anchoring junctions called fibronexus. When ECM stiffness goes beyond 20kPa, alpha-SMA and beta-cytoplasmic actin filaments wire together and create the typical cytoskeletal structure of myofibroblasts (80, 108, 113, 115, 120).

Whereas muscles produce "contractions" that are fast but energetically expensive, myofibroblasts elicit "contractures" that are slow – they take 30 minutes to reach their maximal intensity –, less energetically expensive, and able to remodel the ECM (113). Various chemical factors, including pH, can induce the production of these contractures by myofibroblasts: an acidic environment increases their responsivity, both to contract or to relax (121). Myofibroblasts seem to be independent of the nervous system (112): it appears they are stimulated to contract by mechanical stimuli and several molecules, but not by electric signals. Acetylcholine, adrenaline, and adenosine have no effect on human myofibroblasts (121); histamine and oxytocin can induce brief contractures, nitric oxide (NO) makes them relax, and mepyramine, a first-generation antihistamine, causes slow and sustained contractures for about 2 hours (112).

Although contractures can be induced by both histamine and an antihistamine, their duration and intensity is different, as well as the resulting outcome. In the case of tissue lesions, for example, histamine favors the production of collagen and alpha-SMA via signaling pathways between mast cells, fibroblasts, and myofibroblasts – wound healing improves (122, 123). Manual therapies that facilitate wound healing can indeed induce mast cells to degranulate many molecules, including histamine (124). On the contrary, several classes of anti-inflammatory drugs, including antihistamines, have deleterious effects on wound repair, in particular in the case of lesions involving tendons and ligaments (85).

Since myofibroblasts are "activated fibroblasts," they appear especially during wound repair (80), a process that can follow two different paths:

1. a physiological path: whenever new ECM is secreted, remodeled, vascularized, and the wound is healed, myofibroblasts undergo apoptosis. Contractures are maintained by a dense reticulum of collagen that replaces alpha-SMA filaments – the ECM becomes more robust (113);
2. a pathological path: myofibroblasts survive and continue to produce ECM and contractures. High inflammation can occur, become chronic and cause fibrosis: this results in wide and hypertrophic scarring of the tissues that lose their functionality (80,

125). Examples of fibrosis are Dupuytren syndrome and scleroderma, besides the classical ones that affect the pulmonary, renal, cardiac, and hepatic organs (108, 110).

In the latter scenario, inflammation also elicits severe mechanical stress – for example, a pulsating and steady fluid flow – that activates myofibroblasts and prevents their apoptosis (120, 126). The greater the stress, the more severe the contraction brought about by myofibroblasts on the ECM, and the stiffer the ECM, the more intense the production of contractures by myofibroblasts. Therefore, fibrosis is determined by a vicious cycle (115), and a correct treatment should act by both regulating inflammation and reducing mechanical tension (108). For instance, it has been shown that splinting a wound increases the granulation tissue made by myofibroblasts, whereas removing the splint induces the disappearance of that tissue and the apoptosis of its cells (127). Myofibroblasts may also derive from many cells other than fibroblasts, especially of mesenchymal origin (115) (Figure 2). Due to EMT, smooth muscle cells, pericytes, bone marrow fibrocytes, Kupffer cells, renal mesangial cells, hematopoietic cells, and other cells may lose their phenotype and become myofibroblasts (32, 99, 108, 110, 128). Since EMT is facilitated by mechanical stimuli, pro-inflammatory cytokines, and acidic extracellular pH, as well as by other stimuli such as hyperglycemia and surgical interventions (102, 108, 109), acting on these variables could reverse the myofibroblasts to their original phenotype.

Indeed, even though myofibroblasts are usually considered incapable of changing their phenotype, some authors showed they can lose alpha-SMA and "recover" their original phenotype, whether epithelial or mesenchymal (115, 129, 130) (Figure 2). One potential method could be to induce the anti-inflammatory nuclear receptor PPAR-gamma (129) through, for instance, caloric restriction, physical activity, antioxidants such as resveratrol, probiotics and a healthy microbiota (131). In particular, antioxidants such as capsaicin (the bioactive compound of chili pepper), grape seed extract (GSE), and superoxide dismutase (SOD) can indeed induce the de-differentiation of myofibroblasts: SOD down-regulates TGF-beta1 expression, whereas capsaicin and GSE reduce the inflammation induced by COX-2 and NF-kappaB. Capsaicin also up-regulates PPAR-gamma (129, 132). Other antioxidants such as sulforaphane, the bioactive compound of cruciferous vegetables, can de-differentiate myofibroblasts through the activation of the transcription factor Nrf2 (129). Manual therapies could also help to revert myofibroblasts: a moderate (20-30% of maximal load) manual stimulation applied to a scar has been shown to decrease TGF-beta1 and collagen production (125). An *in vitro* simulation of manual medicine treatment showed an increase of TGF-beta3 as compared to TGF-beta1 (133): TGF-beta3 reduces the production of TGF-beta1 and promotes wound healing (134). Besides, many studies showed that manual and mind-body therapies can increase vagal tone (25), which regulates inflammation, and remodel fascia (135) via mechano-transduction pathways such as integrins (136), even in the case of adhesions, fascial fibrosis, and scleroderma (137, 138).

ACUTE AND CHRONIC EFFECTS OF STRESS AND IMMUNITY ON FASCIA, MUSCLES, AND BONES

During acute stress, the modifications of the body structure aim to deal with the actual stressor and to elicit adaptation (139, 140).

Under chronic stress, this adaptation could become highly expensive for the fascial system, since chronic stress is often accompanied by chronic inflammation (7, 8) and the immune system principally acts in the connective tissue (80).

Fibroblasts, myofibroblasts, adipocytes, mast cells, lymphocytes, and vascular cells can release pro-inflammatory cytokines such as IL-1, IL-6, and TNF-alpha, which increase the production of MMP, proteases, and reactive oxygen species (ROS) (92, 141, 142). We can summarize the effects on the body in two different scenarios:

1. cytokines and enzymes can fragment the ECM network, thus weakening the connective tissue (141). Prolapses and tissue permeability may emerge because the fibers become unable to bear the weight of organs and the epithelial barrier is damaged (143, 144). The facilitation of microbial and neoplastic growth and tissue infiltration may be another undesired result (81);

2. the excessive amount of ECM components excreted by the cells fills more and more space, replacing local tissue (epithelial, muscular, or nervous) with connective fibers and inducing fibrosis (32, 108, 110).

These effects can come from a sustained cytokine increase of only two to three times their normal value – defined "low-grade chronic inflammation" (LGCI). Contrary to acute inflammation, which displays a 100-fold and fast cytokines rise, LGCI takes time to alter organic functions and induce symptoms, however when they finally manifest, inflammation has been acting for a long time (144). LGCI can be avoided or limited through a lifestyle based on healthy nutrition and adequate physical activity; the two latter factors could contribute to LGCI more than any other – the consumption of high-glycemic load foods and exercising beyond one's capacity, for example, are recognized as highly pro-inflammatory (145, 146).

Besides inflammation, the stress hormones strongly affect the ECM and the status of the fascial system, muscles, and bones (9, 142).

Acute and chronic effects of cortisol on fascia, muscles, and bones

Under acute stress, cortisol activates type-2 immunity with anti-inflammatory effects and cooperates perfectly with mechanical stimuli in remodeling muscles and bones to ensure that these tissues can adapt to everyday stimuli and become stronger. On the one hand, glucocorticoids raise protein degradation in muscles, activate osteoclasts in bones and reduce the blood and water flow through bone canaliculi.

On the other hand, the mechanical stimuli elicit muscle contractions that augment that same flow inside bones, blunt osteoclasts activity and induce new bone mass secretion by osteocytes (139, 140, 147).

Moreover, even if cortisol reduces intestinal absorption of calcium and increases its renal excretion, the parathyroid glands secrete parathyroid hormone (PTH) to increase the production of vitamin D, which raises both calcium and phosphorus absorption. In order to prevent hyperphosphatemia – dangerous for both brain and heart – bones secrete fibroblast growth factor 23 (FGF23) that increases renal phosphorus excretion (140).

Under chronic stress, cortisol excess inhibits the WNT signaling genetic pathway, which is fundamental for bone development, and increases FGF23 production, which can lead to renal and cardiovascular diseases, thymus atrophy, asthenia and mental status alteration (140). Cortisol excess induces high inflammation and type-3 immunity that greatly activates osteoclasts – which are macrophages (148) – through IL-17 production, thus increasing bone fractures and osteoporosis risk (149).

Cortisol excess also prevents bones from producing osteocalcin – a hormone that affects the whole organism. Indeed, osteocalcin (i) increases the number and size of pancreatic cells and facilitates insulin secretion; (ii) induces adipose tissue to release the anti-inflammatory adiponectin and augments insulin-sensitivity and energetic metabolism; (iii) induces testicles to produce testosterone; (iv) stimulates the brain to produce monoamines to protect from anxiety and depression and improve learning abilities and memory (150). After the organism recognizes a sudden danger, osteocalcin can even activate the fight-or-flight stress response in case of adrenal insufficiency (151)!

Even LGCI, hyperglycemia, and obesity can blunt the secretion of osteocalcin (152). Luckily, vitamin D, calcium, and especially vitamin K increase its production and activation (153). There are two main forms of vitamin K, i.e., phylloquinone (K_1) and menaquinone (K_2), and it seems K_2 has a greater protective effect on bones than K_1 (153).

Good sources of vitamin K_1 are green leafy vegetables and brassicas, whereas good sources of K_2 are egg yolk, fermented foods (sauerkraut, cheese, fermented soybean), a good microbiota, liver, and butter (153).

Under chronic stress, cortisol induces muscles to produce myostatin that degrades proteins and causes the atrophy of type IIx fast-twitch fibers, which allow muscular strength (139). Cortisol can also induce tendon atrophy since it is a catabolic hormone. Indeed, chronic production of cortisol up-regulates MMPs expression in fibroblasts, facilitates ECM degradation, and reduces the concentration of important growth factors – MMPs can cleave growth factors. Since MMPs are pro-inflammatory, cortisol can greatly modify the connective tissue inside the organs and alter organic functions (154, 155).

For example, in most cases, the so-called tendinitis is tendinosis with poor inflammatory infiltrate and highly degraded collagen. Therefore, therapeutic exercise – in particular, eccentric loading –, relative rest, and posture correction can manage these tendinopathies better than local glucocorticoids, which can worsen the situation (156, 157).

At last, cortisol excess causes the growth of adipocytes, with subsequent accumulation of visceral and intramuscular fat that alters the functioning of the involved organs and leads to LGCI (158).

Acute and chronic effects of adrenaline and noradrenaline on the fascia

Under chronic stress, catecholamines can have deleterious effects on the body structure. Noradrenaline excess due to high sympathetic tone elicits macrophages to produce ROS, especially superoxide via NADPH-oxidase (142, 159). It also down-regulates beta2-adrenergic receptors (79), induces the differentiation of Th17 immune cells (63) and increases MMPs secretion (160), all effects that lead to a TGF-beta1 increase.

ROS and TGF-beta1 can cause tissue damage and induce fibroblasts to differentiate into myofibroblasts (116). Since these cells are not under the direct influence of the nervous system, TGF-beta1, ROS, and MMPs could constitute the link between SNS and myofibroblasts (113, 118, 160, 161).

During acute stress, the release of ROS, MMPs, and TGF-beta1 is extremely helpful: these molecules sustain wound healing and protect from infections (96). But the connective tissue remodeling and the appearance of myofibroblasts induced by chronic SNS activity can cause fibrosis, tissue adherences, and scars, which become even larger and stiffer due to myofibroblasts contractures (113, 118).

These mechanical tensions can reach the cellular nuclei, where they alter the expression of several genes, change the cellular biochemistry and increase the production of pro-inflammatory cytokines and growth factors, which can predispose to neoplastic proliferation (113).

Wound healing is a perfect example to understand the different effects of catecholamines under acute versus chronic stress. Usually, adrenaline slows the activity of epithelial cells and induces fibroblasts to proliferate, migrate to the wounded area, change their cytoskeleton, and secrete collagen to heal the lesion. After the stress response stops, the decrease in adrenaline switches off fibroblasts and allows epithelial cells to complete wound healing (162). Under chronic stress, adrenaline excess blocks the migration of epithelial cells towards the wounded area and alters the fibroblasts production of collagen via beta-adrenergic receptors. Adrenaline excess can either inhibit fibroblasts growth or induce the differentiation of myofibroblasts that elicit strong contractures in the lesion surrounding tissues, thus impairing the wound healing process (163, 164).

Interactions between HPA axis, sexual hormones, and fascia

Since growing evidence shows the presence of sex hormone receptors in the myofascial system – we can find estrogen receptors in synoviocytes, anterior cruciate ligament fibroblasts, and in the blood vessel wall cells of this ligament (165–167) – we choose to dedicate a paragraph to their interaction with fascia.

In vitro, physiological doses of estradiol reduce collagen synthesis and fibroblasts' proliferation by more than 40% in the anterior cruciate ligament. Estradiol inhibits collagen

synthesis induced by physical activity through insulin-like growth factor-1 reduction (165). During the follicular phase of the menstrual cycle, estrogens modify the collagen structure and induce an increase in ligament laxity. These hormones also elicit fibroblasts to produce collagenase, an enzyme that degrades collagen and facilitates organ prolapse and ligament rupture in case of excess exposure to estrogens (166). Therefore, clinicians must investigate whether their patients with chronic pain are under hormonal therapies, including contraceptive pills – their assumption being associated with a high risk of low back pain, bone fractures, persistent pelvic pain, and articular pelvic instability (167).

Androgens can elicit leukocytes to produce TNF-alpha, which induces fibroblast to slow down wound healing and collagen deposition. But androgens seem to induce the migration of epithelial cells (especially keratinocytes) towards the lesion site, as if trying to re-epithelialize the wound before the underlying connective tissue has been repaired. We could argue androgens facilitate wound healing from the outside in – internal mucosa appears to be healed better by androgens than by estrogens, maybe because it is highly vascularized (168, 169).
As a complement to androgens, estrogens speed up the connective tissue healing in case of cutaneous wounds, and also decrease inflammation and ameliorate the symptoms of diseases such as psoriasis or melanoma (170). However, estrogens – and progesterone – induce the production of type-2 cytokines (171): in case of excessive production or external stimuli such as contraceptive pills, estrogens could thus favor LGCI.

Maybe due to this reason, estrogens correlate with cellulite, which is a typical female phenomenon, even though it can manifest in men with low or null levels of androgens, and can be linked to inflammation (172, 173). Indeed, cellulite seems to manifest when estrogens increase more than progesterone, which naturally happens during puberty, pregnancy, and menopause, and forcefully under contraceptive pills or hormonal replacement therapy (172). Estrogens increase MMPs, whose physiological effects on collagen constitute the origin of cellulite, according to some authors (174). That some degree of cellulite could be natural and beneficial is supported by the evidence that it appears primarily in the typical female adipose tissues, especially gluteofemoral, which function as a reserve for pregnancy and breastfeeding to obtain energy, steroids, etc. Therefore, although not all women have cellulite, it could represent a greater reserve (174).

Cellulite becomes a problem when the organism's health changes (173): inflammation and stress can indeed strongly affect cellulite through MMPs (173, 174). Besides, whereas gluteofemoral superficial adipose tissue (SAT) usually shows a high production of the beneficial adiponectin (175), that same tissue expresses a low adiponectin level in the case of a large amount of cellulite (176). Gluteofemoral SAT affected by cellulite displays damages in the vascular system due to high pressure, which is both high blood pressure due to increased levels of angiotensin II and high mechanical tension due to adipocytes' growth (173). This results in water and GAGs retention, tissue hypoxia, loss of elastic fibers (177), and more inflammation (176).

Moreover, estrogens increase HPA axis reactivity: since the stress response can increase steroidogenesis, a vicious cycle between psychosocial problems and tissue alterations could occur (178). In this scenario, prolactin secretion could be involved (177) since cellulite shows high inflammation and a large amount of adipose tissue, which can be both induced by prolactin (177, 179). Prolactin allows breastfeeding and is released in large amount during orgasm, but it also increases in combination with several psychosocial stressors such as anger associated with humiliation, loss, neglect, social loneliness, or the feeling of having to take care of lonely others (e.g., little children who lost their parents) (180).

Therefore, reducing the burden of these stressors could help to resolve cellulite.

Interactions between immune cells and connective tissue

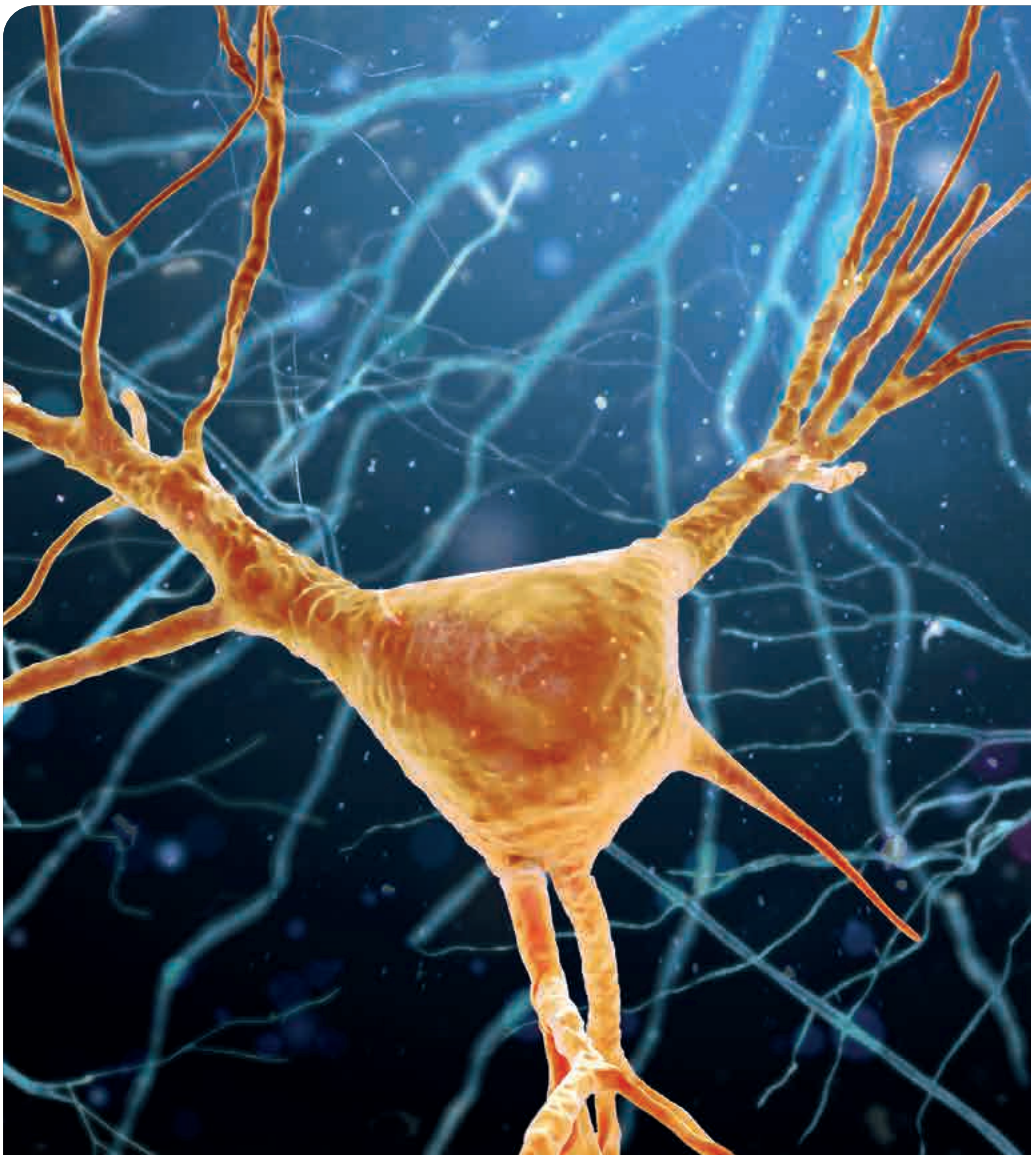
To show how immune cells can impact the fascia, this section describes the behavior of some specific white cells – macrophages, neutrophils, and mast cells – during acute and chronic responses and their interaction with the ECM.
Macrophages balance the equilibrium between wound healing and fibrosis and regulate inflammation affecting the behavior of fibroblasts, epithelial (e.g., mucosal and cutane-

ous), and white cells (181). They can circulate (monocytes) or reside in tissues (actual macrophages): since they regulate tissue integrity and the growth of cells and blood vessels, their absence in tissues can cause serious problems in organic growth. It's worth noting that cells such as osteoclasts and microglia are macrophages (148). Macrophages show two phenotypes that can link to the four immune responses, although they only represent the two extremes in a continuum of different phenotypes with intermediate characteristics (148, 181, 182).

1. the first phenotype (M1) is associated with type-1 and 3 immunity. M1 macrophages stimulate fibroblasts to transform in myofibroblasts and induce wound contraction and collagen production. They favor myofibroblasts survival via TGF-beta secretion and activate the pro-inflammatory transcription factor NF-kappaB. M1 macrophages secrete antimicrobial molecules as a first-line defense against infection and recruit other white cells;
2. the second phenotype (M2) is associated with type-2 and regulatory immunity. M2 macrophages promote inflammation resolution and tissue healing via leukocytes apoptosis and anti-inflammatory cytokines such as IL-10, which regulates MMPs secretion, reduces ECM production, and allows the removal of connective tissue in excess. M2 macrophages also compete for nourishment (e.g., arginine) against other white cells and myofibroblasts, thus reducing the activity of the latter.

These two phenotypes can self-regulate: for instance, M1 Kupffer cells (the hepatic macrophages) infected by already neutralized microbes undergo apoptosis and release IL-33 and IL-4, which polarise nearby macrophages towards M2 phenotype. The result is good healing of hepatic tissues (181). Although M1 facilitates tissue fibrosis, in a healthy organism M1 is regulated by M2, and thus tissues can heal (148, 181). On the contrary, when an organism displays a hyperactive HPA axis, a high sympathetic tone and LGCI, both M1 and M2 macrophages recruit other leukocytes – in particular, Thelpers and ILCs – and favor fibrosis: M2-secreted IL-13 and TGF-beta stimulate the production of MMPs and activate myofibroblasts (181).

M1/M2 polarization depends on the surrounding environment: it can be induced by both chemical (e.g., cytokines, growth factors, and hormones) and mechanical stimuli (182, 183). All white cells are mechanosensitive, and macrophages are no exception: if ECM is under normal tension, macrophages assume an elongated shape whereby actin is more dispersed at the cell periphery so that anti-inflammatory M2 polarization occurs. Whenever fascia is under high tension (e.g., stiffness due to myofibroblasts contractures, fibrosis), macrophages assume a round shape whereby F-actin accumulates around the nuclei, so that M1 polarisation occurs – stiffness facilitates macrophages attachment and



spreading. However, if macrophages are stretched by nearby cells, they can shift towards the M2 phenotype (183).

Therefore, as with myofibroblasts, regulating inflammation and mechanical tension become paramount. Neutrophils represent the major leukocyte population and the first to reach wounded tissues, where they activate and sustain inflammation (65). Neutrophils are constantly produced by the bone marrow and, in the case of chronic inflammation, they can become the main regulators of innate and adaptive immune responses (65, 184).

Neutrophils phagocytize debris, degranulate antimicrobial molecules and release opioids in wounded tissues having an analgesic effect (185). Like macrophages, neutrophils show two phenotypes – i.e., the inflammatory N1 and the anti-inflammatory N2 – and recruit lymphocytes via the release of cytokines, alarmins, and cellular DNA.
Neutrophils can also dampen tissue damages capturing danger-associated molecular patterns (e.g., uric acid) through releasing "neutrophil extracellular traps" (NETs) (185).

NETs are decondensed chromatin meshes bound to DNA, histones, granular antimicrobial peptides, and enzymes such as cathepsins and elastase, which block and destroy pathogens (185). When produced in excess, NETs can cause conditions such as thrombosis, arteriosclerosis, and autoimmune diseases since they contain inflammatory and auto-antigenic substances such as free cellular DNA (186). Indeed, several autoimmune pathologies that affect connective tissue – e.g., rheumatoid arthritis, lupus, vasculitis, and dermatitis – show a high neutrophils activity (184, 185, 187). A possible reason that explains connective tissue involvement in such pathologies is that neutrophils release NETs after tissue trauma and lesions – even of surgical nature (186).

The signals inducing NETs include ROS, cytokines, and molecules secreted by activated epithelial cells, which are more prone to release pro-inflammatory factors and interact with leukocytes – thus, activated epithelial cells can become myofibroblasts (186). Therefore, the stress response could heavily influence neutrophils behavior. Indeed, physical stress such as moderate exercise can help to control neutrophils activity since it releases DNase, an enzyme that reduces free DNA concentration – it regulates both NETs formation and degradation and decreases the risk of thrombosis (188).

On the contrary, an intense physical activity would release a great amount of ROS, with a consequent increase in neutrophils tissue infiltration, inflammation, and pain perception (188). Regulating neutrophils activity should be of the foremost importance since neutrophils can also resolve inflammation, elicit revascularization and limit the onset of fibrosis by excreting IL-1 receptor-alpha, TGF-beta, and specific lipids that mainly originate from omega-3 fatty acids – these lipids inhibit neutrophils afflux and polarise immune cells towards an anti-inflammatory phenotype (184, 185, 189, 190).

Mast cells are greatly influenced by the stress response and appear in a high amount in connective tissue (80). Mast cells can provoke a fast inflammatory response due to the ready-to-be-released pro-inflammatory molecules they contain, i.e., histamine, serotonin, IL-1, IL-6, TNF-alpha, IFN-gamma, TGF-beta, proteases, prostaglandin, leukotrienes, growth factors, NO, heparin, adenosine triphosphate, and calcitonin gene-related peptide (191).

Mast cells can be activated by many stimuli, in particular, by mechanical and psychosocial stress: a stiff and fibrotic ECM induces mast cells degranulation and proliferation (192), whereas emotional stress causes mast cells to increase inflammation and the symptoms of allergic conditions such as asthma (193, 194). Mast cells are part of the type-2 immune subsystem, which can be induced by glucocorticoid and catecholamines (195) and, in case of danger, by chemical signals deriving from afferent nerve pathways (e.g., wounds, infections) – it's the "neurogenic inflammation" (196).
Connective tissue mast cells are different from other mast cells because they contain both tryptases and chymases (80). While tryptases stimulate fibroblasts to produce more proteins and recruit neutrophils and basophils, chymases convert angiotensin I into angiotensin II facilitating hypertension, have anti-parasitic effects and degrade several growth factors (141).
Both tryptases and chymases degrade the ECM to remodel it (141) – for example, warm-up exercises increase temperature, activate muscle metabolism and release tryptases

and chymases to soften the myofascial system and facilitate the physical effort.

These enzymes can also cleave pro-inflammatory molecules (e.g., cytokines, P substance, and endothelin I), thus lowering inflammation: mast cells can indeed blunt neutrophil tissue infiltration through heparin and histamine release (141).

A chronic mast cell activation can make fascia fragile and permeable through releasing MMPs, but it can also induce fibroblasts to transform into myofibroblasts, thus facilitating fibrosis (122, 197, 198). However, without mast cells, the immune system could not mount a timely reaction against infections and venoms (141).

Balanced nutrition and healthy gut microbiota greatly help to harness optimal mast cell activity since they can both regulate mast cell degranulation: antioxidants and commensal microbes can protect from ROS, venoms, and pathogens without activating an inflammatory response, thus leaving the mast cells to degranulate only when truly needed (199, 200).

Summary of the effects of stress and immunity on the body structure

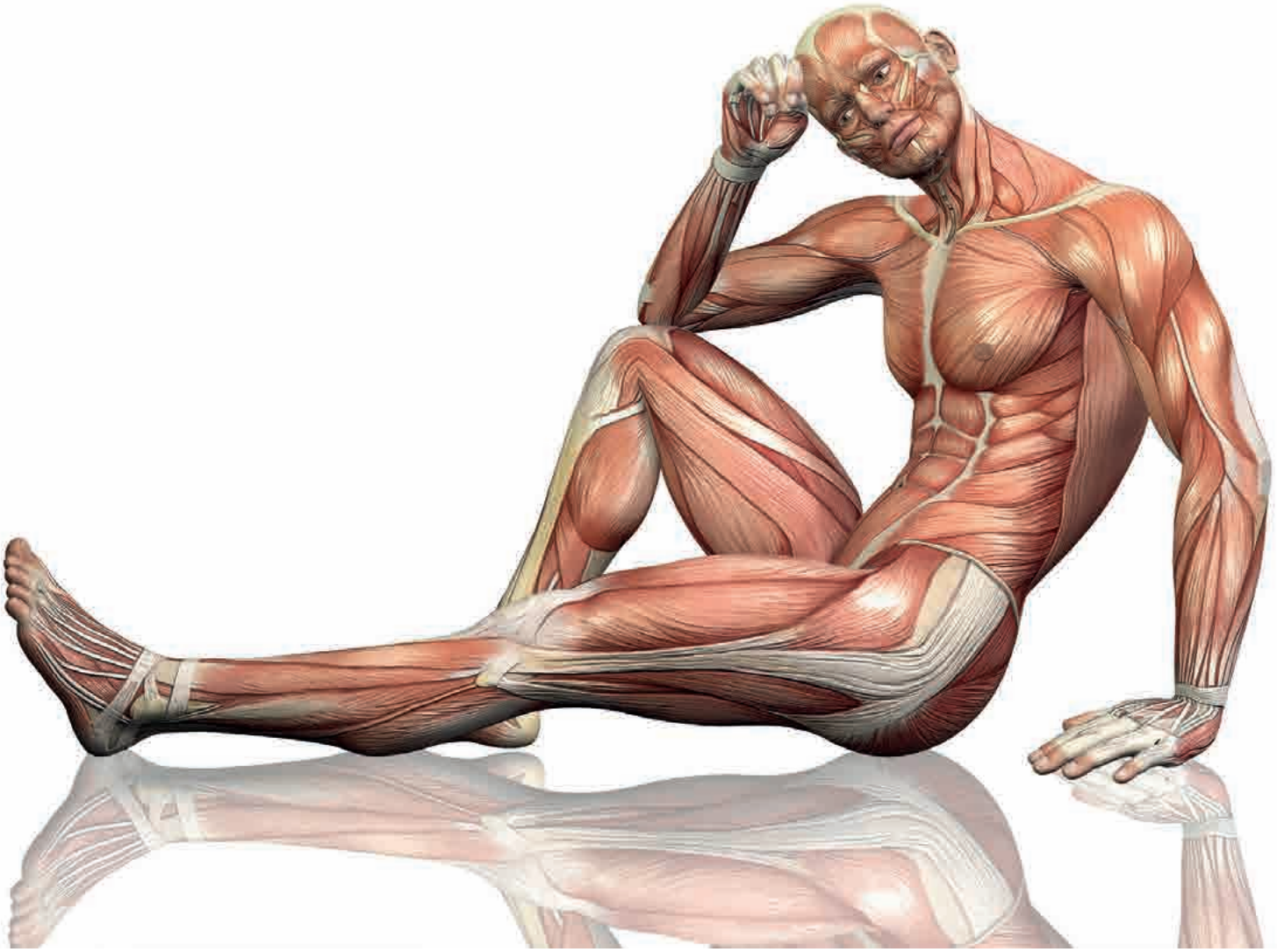
Glucocorticoids and catecholamines can differently affect connective tissue, muscles, and bones. Their effects can be direct or mediated by molecules such as cytokines, MMPs, and ROS or by the recruitment of immune cells such as T lymphocytes, macrophages, neutrophils, and mast cells. In all cases, an organism induces the production of glucocorticoids and catecholamines and activates the immune cells when it is striving to cope with the environment. Hence, these molecules have

a purpose and help the organism to remain healthy and become stronger (e.g., the body gains strength and health after a good physical training) (146).

However, the duration of the stress response and the immune activity can bring about deleterious effects on tissues: chronic stress and inflammation can induce muscles and tendons atrophy, induce connective tissue and organ fibrosis, cause osteoporosis and bone fractures, increase fluid retention and inflammation (e.g., cellulite) and facilitate adipocyte growth.

These effects can have systemic consequences since they can influence the production of many signal molecules – for example, osteoporosis is linked with reduced osteocalcin secretion (150), adipocytes can induce hypertension (158), and MMPs can reduce growth factors (155) – and thus threaten health.

Therefore, strategies that limit the deleterious effects of chronic stress and inflammation – in particular, anti-inflammatory diet, correct physical activity, good sleep hygiene, social support, and stress relieving – are paramount to regulate for the better the interaction among these systems (3, 7).



CONCLUSIONS AND IMPLICATIONS FOR BODYWORK THERAPIES

Papers similar to the present one can help manual therapists in better understanding their practice, as emphasized by the following examples. During the manual palpation of a scar, therapists often feel tissue relaxation, expansion and "breathing," and myofibroblasts usually manifest a rhythmic contraction every 99 seconds – curiously, this rhythm matches the 100s time defined as "life breath" or "long tide" by Sutherland in the osteopathic field (118).

This rhythm is due to intracellular Ca^{2+} oscillations and increases with inflammation: therefore, myofibroblasts produce faster contractures during inflammation (201). But a manual stimulus can reverse this acceleration via the relaxation of adherens junctions between myofibroblasts (and likely via the reduction of inflammation) (25), thus restoring a slower rhythm – this change can feel like a "tissue release" (118).

In-depth knowledge of the connective tissue can also assist in selecting the most appropriate physical loads and forces to be applied to restore the correct collagen structure after a lesion: different loads induce the production of different types of collagen.

Similarly, knowing the mechanisms by which wound healing is affected by health, stress response, inflammation, and manual therapies can be useful for therapists to comprehend which procedures could obtain the best outcome.

This information could also help surgeons, improve aesthetics medicine and promote integrative medicine in the context of preemptive healthcare and in the management of patients with chronic musculoskeletal pathologies. Knowing the relationship between stress, immunity, and fascia helps to understand that the outcome of medical and manual therapies can be boosted or curtailed by the person's experiences: any beneficial effects of medical and manual treatments can be nullified by psychosocial adversities and lifestyle (e.g., physical inactivity, high glycemic index, and load nutrition) that trigger high inflammation.

Notwithstanding that manual therapies can have systemic effects – they can reduce cortisol, SNS activation, and inflammation, increase oxytocin secretion and vagal tone and remodel collagen (11, 25, 29–31, 202) – they remain an isolated event in everyday life that must be integrated with other interventions such as patient education, physical exercise, lifestyle changes, and psychological therapies (as shown by the recommendation in the case of low back pain) (203).

Pain in itself, as a perception, does not strictly depend on local structural alterations but originates from cerebral elaborations of every endogenous and exogenous information, the result of which affects the organism via nervous, immune, and endocrine pathways (10, 202, 204). Inflammation, emotions, beliefs, expectations about pain and body movements, and lifestyle can all greatly impact pain, and knowing their influence can help to assist the patient in coping with pain (202, 205).

Many physicians and manual therapists often treat the painful area or other body structures that are physically connected to it, but this can be noxious if there is no real lesion, because it can reinforce the belief that a lesion does exist, and consequently heighten the patient's fear and avoidance of healthy movements (205).

Physicians and manual therapists should evaluate every possible structural lesion and act accordingly, but should also address the patient's biopsychosocial needs (1, 206). Since pain is a central response to psychophysical danger (10), the organism can keep producing pain as long as it detects a threat – physical wounds, bad digestion, environmental toxins, inflammation, infections, poor sleep, loneliness, low self-efficacy, fear, low socio-economic status, and so on. Only by addressing all these factors, pain can be managed – our goal should be to understand why the organism thinks it needs pain, and find strategies to support the person in everyday life (10, 204, 205).

For instance, since psychosocial stress can induce fascial alterations and alter immunity responses, a therapy that ignores stress management might never resolve fascial alterations. The organic effects of stress can be countered through pharmacological, surgical, or other interventions; however, this would not ad-

dress the initial cause – stress – putting the person at risk of developing other pathologies. Indeed, as long as it detects a threat to its integrity, the organism can ceaselessly continue to elicit the stress response (1, 18, 206–209). This reasoning holds for all health conditions (1, 18, 206) and can make us better comprehend what occurs inside patients, why sometimes nothing seems to relieve their pain or condition (205, 206).

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Abbreviations: HPA: hypothalamic-pituitary-adrenal axis; CRH: corticotropin-releasing hormone; ACTH: adrenocorticotropic hormone; AVP: arginine vasopressin; OXT: oxytocin; SNS: sympathetic nervous system; TRH: thyrotropin-releasing hormone; PVN: paraventricular hypothalamic nucleus; RVM: rostral ventromedial medulla; IL: interleukin; ANS: autonomic nervous system; ECM: extracellular matrix; ILC: innate lymphoid cell; NK: natural killer; Th: T helper lymphocyte; IFN: interferon; TGF: transforming growth factor; AGE: advanced glycation end-product; GAG: glycosaminoglycan; MMP: metalloproteinase; EMT: epithelial-mesenchymal transition; NF-kappaB: nuclear factor kappa B; SMA: smooth-muscle actin; LLC: large latent complex; NO: nitric oxide; PPAR: proliferator-activated receptor; Nrf2: nuclear factor erythroid 2-related factor2; GSE: grape seed extract; SOD: superoxide dismutase; COX: cyclooxygenase; ROS: reactive oxygen species; LGCI: low-grade chronic inflammation; FGF: fibroblast growth factor; NADPH: nicotinamide adenine dinucleotide phosphate; SAT: superficial adipose tissue; M1: type-1 macrophage; M2: type-2 macrophage; DNA: deoxyribonucleic acid; NET: neutrophil extracellular trap.

Key Words: Stress, Glucocorticoids, Catecholamines, Immune system, Fascia, Connective tissue, Myofibroblast, Mechanobiology, Psychoneuroendocrineimmunology, Review

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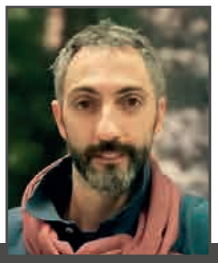

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STATURAL GROWTH IN YOUNG OLYMPIC WEIGHTLIFTERS

BY MARCO CUTILLO

Among the clichés that penalize the noble practice of Olympic Weightlifting is the one referring to the alleged arrest of the height growth of its athletes, especially if they take up the sport in prepubertal age.

These are obviously clichés without any scientific basis that do not consider the role of the selection carried out during the recruitment phase by talent scouts who, in order to comply with the specific performance model, must privilege particular anthropometric characteristics typical, in our discipline, of short-limbed individuals.

In this regard, it would be interesting to know whether even horse riding, in which the jockey is quintessentially of short stature, and artistic gymnastics, can determine the presumed stunting of growth mentioned in the introduction.

Studies and research provide scientific answers in this regard, demonstrating that statural growth is a factor strictly governed by genetics, influenced by hormonal factors linked to the correct functioning of the pituitary-hypothalamus axis; moreover, the presence of Tanner's formula (1970) for the approximate calculation of the target height, simply taking into account the height of the parents, provides further confirmation on the predetermination of the height of an individual.
The study carried out at the Rita Levi Montalicini Middle School in Capurso (Bari) is part of this context, aimed at verifying the possible effect of the practice of Olympic Weightlifting on the growth process of its young athletes.

The working methodology adopted during the study involved the examination of a sample of 101 youths of both sexes, 66 males and 35 females, and aged between thirteen and fourteen years. Their height was registered using a wall altimeter, in three different moments of the school year:

a. beginning of the year;
b. after the Christmas break;
c. at the end of the school year.

When acquiring the measurements, the participants removed their shoes; they were asked to keep their legs straight, heels and ankles touching, with toes slightly apart (at 60 degrees); the occiput, shoulder blades, buttocks and heels remained in contact with the wall; the weight was evenly distributed on both feet and the arms extended at the sides with the palms of the hands facing the thighs. The participants also positioned themselves with the line of vision in the Frankfurt plane (plane that passes between the auditory foramen and the inferior margin of the orbit), parallel to the support base; the movable part of the altimeter was placed in contact with the head, exerting slight pressure to compress the hair, free from braids, headbands and anything else that could alter the measurement of the height.

The collected data, inserted into a database using the OpenOffice Calc program, were divided into tables creating two groups: the first, "experimental", (divided between

males and females) comprising boys and girls practicing Olympic Weightlifting at least three times a week, in training sessions lasting about an hour which involved the use of overloads aimed at participating in competitive competitions; the second, "control" (also divided by sex), which included all those who did not practice this sport and, therefore, included sedentary individuals or those practicing other sports.

At the end of the school year, therefore, the data was analysed by calculating the average variation in growth of the individual groups. The below is a summary table of the results (data in metres):

SEX	WEIGHTLIFTING	INITIAL AVERAGE HEIGHT	FINAL AVERAGE HEIGHT	AVERAGE VAR.
Males	Total	1.57	1.6	0.03
	Yes	1.58	1.62	0.04
	No	1.57	1.59	0.02
Females	Total	1.54	1.55	0.01
	Yes	1.54	1.57	0.03
	No	1.54	1.55	0.01

The table highlights how the experimental group of Olympic weightlifters recorded an average variation in height growth greater than the control group: 4 cm in the group of males (as opposed to 2 cm in the non-practising youths) and 3 cm in the group of females (as opposed to 1 cm in the "control" group).

The above, referred to a time span of about ten months, is confirmed by the data collected on three other athletes, class 2000, who have been practicing Olympic Weightlifting at a competitive level for two years with an average number of 5 weekly training sessions.

The study carried out, therefore, demonstrates how the boys and girls practicing Olympic Weightlifting enjoy a process of constant statural growth, on the same level if not greater than the other peers examined, be they sedentary or practicing other sports, thus denying the fears of a potential "growth stunt".

NAME	SEX	WEIGHTLIFTING	1ST HT	2ND HT	DIFF.
Student A	M	Yes	1.66	1.73	0.07
Student B	M	Yes	1.55	1.64	0.09
Student C	M	Yes	1.57	1.65	0.08
			1.59	1.67	0.08

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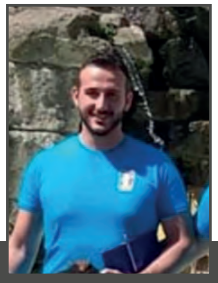

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The official journal of the European Weightlifting Federation

POLYVAGAL THEORY, EMBODIED COGNITION, PERCEPTION-ACTION

THE POLYVAGAL THEORY AND THE ROLE OF SAFETY: EMOTIONAL AND BEHAVIOURAL SELF-REGULATION AND CO-REGULATION IN PLAY.

THE PROJECT: PLAYING WITH EMOTIONS

BY ANTONIO MAZZONI, MARIA PIA ALBANESE, ANNAROSA CARADONNA

The official journal of the European Weightlifting Federation

HERE, IN BRIEF

With the contribution of neuroscience, this article aims to highlight how play enables complex psycho-physical experiences, changing the network of neural connections, both central and peripheral, reorganising the traces of experiences, even those linked to unpleasant and/or traumatising experiences. Play, both in its intrapsychic and interpersonal dimensions, can modulate and co-regulate, in its relationships with others, the internal states of the participants. The Polyvagal theory of S.W. Porges, the Sensorimotor therapy of P. Ogden, the Attachment theory of M. Ainsworth and J. Bowlby, the OKness philosophy of Stewart and Van Joines, the Triune Brain theory by MacLean, the theory of Affect Regulation by A. Shore, the theory of Mirror Neurons by Damasio are all the reference matrices within which the psychomotor project, "Playing with emotions" is realized, which aims to favour the harmonious development of the child within an experiential, relational, affective and positive context, including disability.

Play, therefore, seen as an evolutionary, creative, and restorative dimension that is essential for the healthy and harmonious growth of the individual.

INTRODUCTION

The new cognitive sciences tell us that emotions are actions and actions are cognitive processes.

In sensorimotor therapy, Pat Ogden and Janina Fisher talk about positive emotions, pleasure and play and how to focus and foster the ability to live pleasant feelings and experiences, often limited by childhoods marked by traumas or disappointments and attachment injuries, which can both heal and enhance the child's developmental potential.

Effective and supportive communication (the OKness philosophy) will facilitate the construction of a safe and meaningful relationship in which the adult mentor will encourage the young person to experience new adventures and encourage multiple learning, offering a wide variety of activities and stimuli that gradually go beyond the "usual standard" of the student, thus increasing motivation and well-being.

The teacher, the parent, the educator, while playing with the child, activates an information circuit that involves what Mac Lean (1985) defines as the "Triune brain".

If we look at the causes that lead a sports athlete to drop-out, among them we will surely find the loss of "pleasure" when playing, a negative relationship with their mentor, the impossibility of being the top player, the loss of one's own meaning. of adequacy and OKness.

The authors highlight: "the need to become aware of the body patterns that hinder the ability to experience positive emotions, pleasure and playful states". In fact, they argue that: "by practicing playful movements, positive emotions will become increasingly accessible" and, as positive emotions and states of both high and low arousal are explored, two fundamental thrusts will be activated: the quest for novelty and the quest for safety. This will result in an extension of the tolerance window and the adequate risk assessment will allow for the experimentation of new activities, outside the comfort area, providing an increase in possibilities and abilities.

The three areas of the reptilian, limbic and neocortical brain correspond respectively to sensorimotor (bodily), emotional and cognitive processing of information, thus contributing to the child's definition of themselves, of the other, of their interaction and of the world.

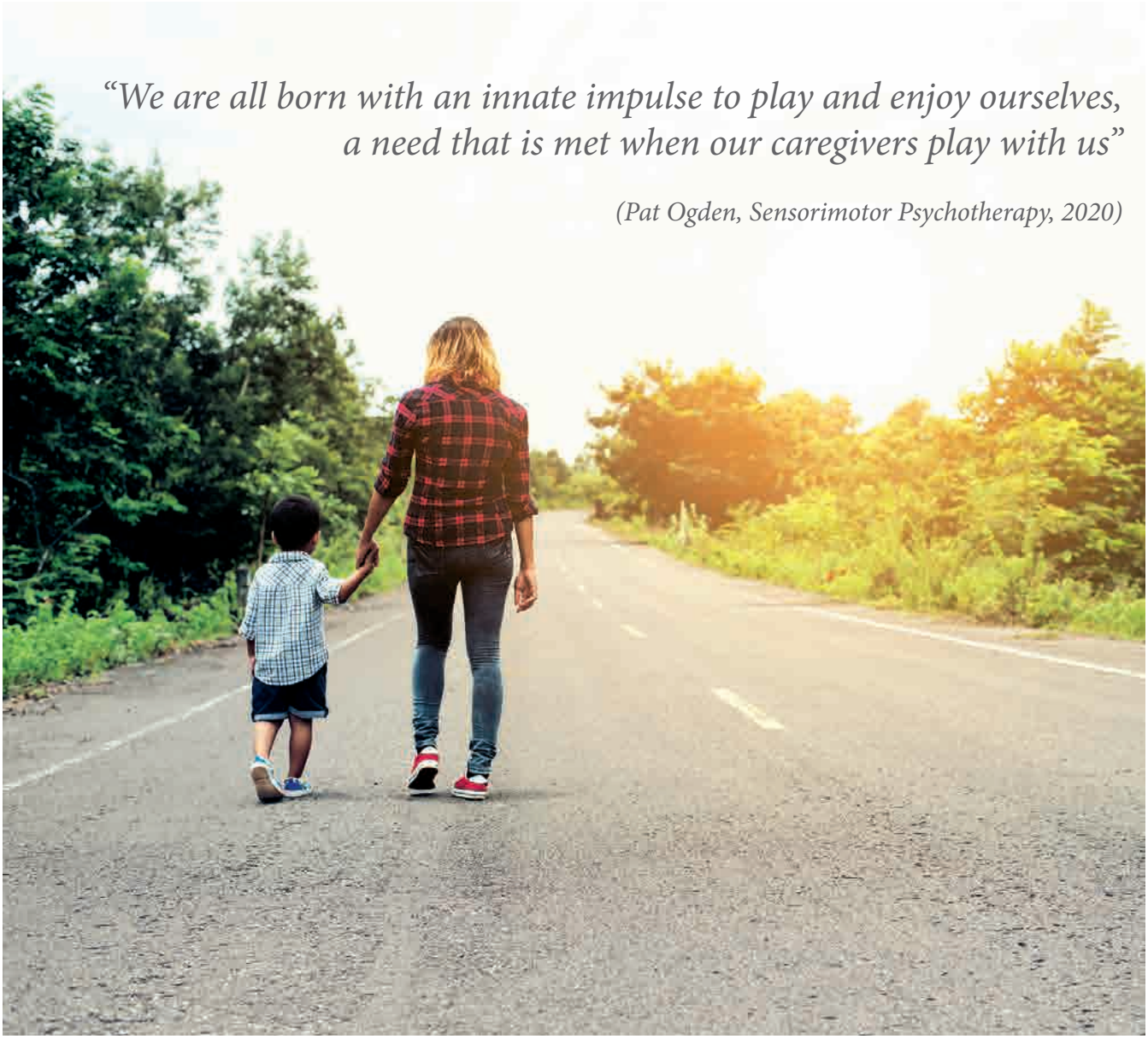
Having information on these "three brains" helps us to better understand why we think and act in a certain way and enables (every careful observer) to support the integration between the three levels of information processing.

Let's take a practical example: we propose to the children (kindergarten) to play "fruit picking". The backdrop to the game is nature and the children pretend to be squirrels picking fruit (coloured balls: red-yellow-blue-green) and putting them into the corresponding containers (red-yellow-blue-green coloured circles). We first observe the free movement, the relationship with the context and between the children and the executive functions involved (inhibition-working memory, problem-solving); we can hypothesize that the part of the neocortex is processing everything safely, the children perform the cognitive task well and also the sensorimotor, or body part is free, harmonious and organised.

Now let's try to undermine these two systems, acting on the third: the "emotional" limbic part. We gather the children around and ask them if they want to add a cunning fox (the teacher) will come and try to steal the fruit they are picking. By saying that the fox wants to steal the fruit and not the squirrel, we insert a criticality that leads to a gradual emotional activation that increases if the child becomes the object of prey. The increase of arousal, the activation of the vagal (sympathetic) system, of the fight/flight (described by Porges in his Polyvagal theory), adequately alternated with moments of low activation, managed by the parasympathetic system and by the calming signals sent by the teacher, generate a profound, regulated and co-regulating relationship.

Observing the children, we will notice that a request that previously seemed easy to execute, will cause distress: they will make a mistake in which circle to put the fruit (e.g., red ball in the green circle); they will no longer be able to move while paying simultaneous attention to space, body and task and the space/time ability will falter.

It is be here that the teacher will have to intervene by modulating and co-regulating the emotional states, becoming part of the game, proposing safety situations (e.g. if the child crouches down, the fox will not see them; the same applies if two children hug each other), finding the right problem-solving activities, so that each child feels motivated, curious and confident in working out their own solution, in a relational and emotional climate full of joy, movement and creativity that will facilitate learning.



THE VAGUS NERVE AND THE AUTONOMOUS NERVOUS SYSTEM: ANATOMY AND PHYSIOLOGY

The vagus (or pneumogastric) nerve is the longest cranial nerve with the largest area of distribution; it represents the tenth pair of encephalic nerves. It is a mixed nerve, therefore it has both sensory and motor, somatic and visceral fibres. The sensory part is the most extensive, which constitutes 80% of its component and carries the greatest number of visceral effector fibres that innervate the viscera of the chest and abdomen.

The somatic motor fibres originate in the ambiguous nucleus of the medulla oblongata, therefore at the level of the brain stem, and innervate the striated musculature of the pharynx, larynx, including the vocal and esophagus muscle (proximal part).

The visceral effector component originates from the dorsal motor nucleus, also in the medulla oblongata, and carries effector stimuli to the heart, aorta, glands and smooth muscles of the respiratory tract, digestive system and a part of the urinary system.

The somatic sensory fibres collect sensory stimuli from a small skin area of the pavilion of the external ear and from the eardrum, from the soft palate, and from the pharynx and larynx, and sends them to the jugular ganglion.

The visceral sensory fibres of the vagus nerve collect stimuli from the aorta and from most of the viscera of the respiratory and digestive systems, therefore at the thoracic and abdominal level. The fibres reach the nodular ganglion.

From the jugular and nodular ganglia, the T-neurons of the sensory fibres reach the nucleus of the solitary tract of the medulla oblongata.

The vagus nerve represents the main component of the Parasympathetic Autonomous Nervous System.

îThe Autonomous Nervous System (ANS) constitutes that part of the Peripheral Nervous System (SNP) that performs a vegetative function, i.e., regulates the function of all internal organs and some muscles, through involuntary responses, allowing the control of homeostasis and the functions of basis of the organism.

The ANS is traditionally divided into:

Sympathetic or Orthosympathetic, which mediates the fight or flight functions (fight or flight);

Parasympathetic, which provides the viscero-sensitive and somato-sensitive functions, aimed at supporting health, growth and energy recovery;

Metasympathetic or Enteric, which controls smooth muscle, blood vessels and intestinal secretory activity.

The sympathetic induces bronchodilation, peripheral vasoconstriction

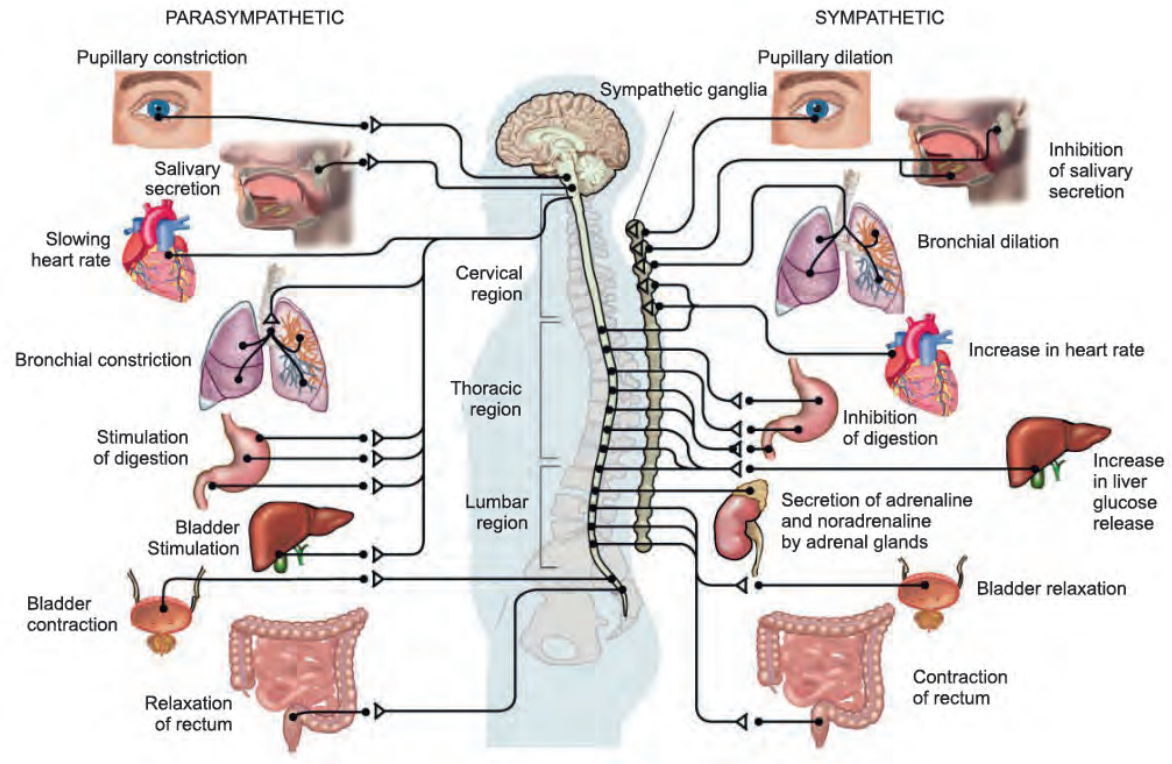


FIGURE 1: Source: www.chiropraticaitalia.it/la-vita-sana/impulso-nervoso/5.

and coronary vasodilation, increased heart rate, dilation of the pupils, contraction of sphincters and spermatic ducts, secretion of sweat glands and contraction of erector hair muscles, the reduction of gastric motility and the production of urine. These reactions predispose the body to the reaction.

The parasympathetic, on the other hand, favours gastrointestinal peristalsis and intestinal mobility, bronchoconstriction, secretion of the salivary, lacrimal, liver and pancreas glands, as well as urination, vasodilation, slowing of heart rate and contraction of the pupils (fig. 1).

Most of these reactions are mediated by the action, as mentioned above, of the vagus nerve.
In classical literature, the sympathetic and parasympathetic systems are considered antagonistic, performing opposite functions on the various organs they innervate. According to Porges, this generalisation does not completely correspond to reality: the fact of not having the need to implement behaviours that support the aggressive impulse does not automatically mean not needing the sympathetic SN and therefore deactivating it; on the contrary, in addition to an fight or flight response, the activation of the sympathetic is important for the organism at different levels.

THE POLYVAGAL THEORY

The term polyvagal suggests the existence of many vagal pathways, the result of an evolutionary change in the neural regulation of the ANS. The theory explains how our physiology is linked to our mental and behavioural states and provides the neurobiological link between the body and the brain and between the body and psychological processes. Porges modifies the way of interpreting the ANS: it is no longer a system in which the sympathetic and parasympathetic, in opposition to each other, move around a balance of their influence on target organs, but a model of hierarchical activation of the neuronal pathways of this system. Underlying everything is the concept that relationships with others make it possible to co-regulate the physiological state and, at the same time, the physiological state influences behaviour and the ability to interact with others.

Porges presents our SNA, as made up of multiple types of neural circuits:

the first and oldest, is a defense response in the face of danger, a type of shutdown and immobilisation (freezing), carried out by the parasympathetic and inherited from our reptilian ancestors;
the second is represented by the fight or flight response, which the sympathetic is responsible for, and which is still a defense response, but characterised by activation and mobilisation, which appeared in later evolutionary periods;
the third circuit is a vagal pathway which constitutes a further evolutionary leap of the ANS made in mammals, which introduces a modulation system, a new component or branch of the parasympathetic, which coordinates the functions of the ANS and supports the activation of the circuits.

The theory claims that there is a hierarchy of activation of these circuits, in which the most recent evolutionary ones inhibit the oldest ones, an unconscious choice of the individual, which is realised as an adaptive response to environmental conditions.

When we are in difficulty or in danger, the regulation of the ANS makes use of gradually older circuits with the aim of survival. This model is consistent with John Hughlings Jackson's dissolution construct, which predicts the disinhibition of evolutionarily older circuits in the event of brain damage or disease.
The ancestral shutdown mechanism, which was fine for simpler organisms, albeit inherited from mammals, was extremely expensive in terms of oxygen consumption and potentially lethal for this species, which is why the more complex species have minimised it, preferring fight or flight reactions to danger.

However, it sometimes happens that mobilisation is, at an unconscious level, considered by the body to be insufficient to guarantee the survival of the individual; in these cases, the system bypasses the sympathetic and opts for the ancestral response of immobilisation, written in our most ancient genes.
The meaning of remaining motionless and sometimes unconscious, in the face of a life-threatening (from immobilisation to fainting, to fake death), has the sense of raising the

pain threshold and lowering the level of awareness, thus resulting in a life-saving mechanism, or the mechanism that the organism at that moment considers the best to be implemented to ensure survival.
However, activating this pathway is not without consequences, since switching off alters the regulation of the vagal system.
This could lead to a disturbance of homeostasis, which could cause a series of cascading medical problems in comorbidity with the trauma. The vagus nerve could also activate defence reactions in the absence of a real danger to life. Therefore, the behaviours implemented in the face of danger, for some people often return to manifest themselves as symptoms, in situations where there is no real risk to life, situations that however send a series of sensory signals to the nervous system, so that the individual does not feel completely safe, and to keep him in a state of alert. For example, we are talking about Post-Traumatic Stress Disorder, whose therapy is the main field of application of the suggestions provided by the Polyvagal Theory, but we are also talking, according to Porges, about autism.

Instead, the more recent vagal component, exclusively pertaining to mammals, in practice, has the task of activating the mobilisation reactions, simultaneously preventing this behaviour from becoming a defensive act, but rather recruiting the same systems to support health, growth and pleasure.

And all this is possible thanks to the integration of this mobilisation system with the social involvement system, which allows, through the evaluation of the social context (for example the expressiveness of the face, prosodic vocalisations, etc.), to recognise the real presence of danger.

This is exactly what happens in PLAY: the fight/flight reactions are integrated with the system of social involvement, in order to produce a behaviour that is defined as prosocial.
In simple terms: the organism, in the absence of awareness, is in a constant condition of evaluation of the environmental context, with the aim of continuously judging the level of safety of the environment and promptly detecting dangerous conditions, in order to react quickly, where readiness in reaction can make a huge difference in the effectiveness of the response, with regard to saving oneself. Porges calls this unconscious perceptual capacity, neuroception.

This evaluation, the result of a tuned co-regulation, seems to take place at the level of the ventral part of the prefrontal cortex and, by activating the ventral vagus, is aimed at emotional regulation (Eippert et al., 2007; Urry et al., 2006). In other words, it is like saying that it is the "sixth sense" and not cognitive reasoning that decides whether where I am in a safe place or not.

The outcome of the assessment determines the almost unconscious choice of the behavioural path triggered to adapt to the context: in the presence of danger, defence reactions will be activated; once the safety condition is ascertained, however, the individual can focus on social relationships, on the actual experience, on learning, on fun, on joy, etc.

SAFETY AND THE SENSE OF CONNECTION AS BIOLOGICAL IMPERATIVES

Mammals are very special beings; they need others to regulate their body states and to survive. Porges argues that the primary biological imperative for humans, and for mammals in general, is to be connected to other human beings, and identifies the true value of life in this sense of connection with other people. Interacting with others is fundamental, and humans needs it throughout their lives: when young they need care and attention, to satisfy the need for safety and nourishment, then they move on to the need for emotional regulation behavioural, or the co-regulation of the physiological state. Human interactions can facilitate neurobiological processes so that the individual can develop its potential.

"We are not machines - writes Porges - we are a living biological system that dynamically interacts with the environment: when we touch something or someone with whom we interact, we touch everything by feeling it within ourselves."

Remember also that Bowlby, in his Attachment Theory, argued that "attachment is an integral part of human nature from the cradle to the grave", first sensing, and then demonstrating, how a harmonious development of an individual's personality depends in an important way on an adequate attachment to a reference figure, a safe haven, from which it can leave without fear to explore the world and return in case of threat, to find comfort and safety.

Attachment, security and the system of social involvement are closely connected and intertwined: social involvement represents the neural platform on which attachment processes take place; a healthy attachment, argues Porges, cannot be separated from a feeling of security.

Many scholars have devoted their attention to this topic, in this regard we recall the Spitz experiment (in the wake of the experiment of Frederick II of Swabia), which demonstrates, by studying the behaviour of post-war orphaned children, who although cared for in orphanages and receiving the necessary physical care, suffered so severely from the absence of attachment relationships that they fell ill and died, almost wasting away.

The importance of the feeling of safety for mammals, and for humans, in particular, is grounded in this need for social interaction: if our nervous system detects the safety condition, it lowers its defensive state and allows the circuits of the SNA to activate those processes that support health, growth and energy recovery. Therefore, the essential prerequisite for the individual to be able to live the experience and have access to higher brain structures, to learn, be productive and develop creativity and problem solving, is to feel safe.

"When we are safe, magical things happen. - says Porges - Magical things happen at multiple levels, not only in terms of social relationships, but also at the level of the accessibility of certain brain areas related to the sensations of pleasure: being expansive, creative, learning. "

Feeling safe therefore has a transformative power, but it also has a non-negligible relevance with respect to places of care and therapeutic relationships.

THE "INTELLIGENT VAGUS NERVE"

Porges distinguishes, in addition to the sensory pathway, two vagal motor pathways, on the basis of the peripheral distribution of the fibres:

- The sub-diaphragmatic vagus is mostly unmyelinated; this vagus is what we share with reptiles, fish and amphibians, which it projects to the intestine and which is responsible for all those "emotions that take the belly".
- The supra-diaphragmatic vagus, on the other hand, is made up mostly of myelinated fibres, and appeared with evolution in mammals; it is involved in the regulation of the muscles of the face, ingestion, listening and social involvement and breathing.

Porges defines the myelinated vagus as "intelligent" and emphasises that it derives from an area of the brain stem that also controls the muscles of the face and head.

The brainstem, seat of the origin of these circuits and nerve centre for the integration of information that comes from both the cortex and the periphery, therefore represents the main regulator of the physiological state, and is fundamental for the maintenance of homeostatic processes that influence our state of health and for the regulation of behaviours, since these are influenced by the physiological state.

The polyvagal theory therefore argues that difficulties in vagal regulation, or more generally autonomic, may cause difficulties in regulating the behavioural state.

Porges invites us to think of the vagus as a bidirectional channel that connects the brain with the body,

involved in both top-down and bottom-up functions, which therefore represents a fundamental neural interface in mind-body and brain-body relationships. He leads us to consider the existence of a reciprocal influence between brain processes and the functioning of peripheral organs.

Our body cannot therefore be defined as a set of organs uninformed about brain processes: but rather, the sensory information, proceeding from the periphery to the brain and colouring perceptions in a widespread manner, influences the way and type of responses we give to the external environment; the brain processes, in turn, influence our viscera through both cognitive and affective processes, linked to the perception we have of the environment itself. Exactly what, perhaps in a slightly more poetic and emotional way, has always supported psychomotor skills, play, and motor education.

THE VAGUS NERVE AND EMOTIONS

Recent studies have shown that the action of the vagus nerve is linked to the functioning of the frontal cortex and the amygdala, brain areas essential for the regulation of emotions (Urry et al., 2006), for the activation of stress contrast systems. (Thayer et al., 2012) and for the implementation of lifestyle-related behaviours (Gidron et al., 2018). In recent years, research has shown how activities and experiences associated with so-called "positive" emotions in the individual improve vagal tone and enhance its functioning, with all that this means for health and psychophysical well-being.

Emotional regulation is a skill that individuals develop during childhood, and which they can enhance throughout their life; this ability allows them to manage emotions and to manifest them in a way that is proportionate to the intensity with which they are experienced, and regulated according to the environmental context, so that it does not constitute a disturbing factor with respect to social interactions and relationships (Denham, 2003).

Emotional regulation is related to cardiac variability (Appelhans and Luecken, 2006; Thayer and Brosschot, 2005) which, as we have already said, is under the direct control of the vagus nerve and is inversely connected to the perception of threatening situations and sensations of danger, while it is directly proportional to the perception of contexts evaluated as safe at the level of the prefrontal cortex, and to all the emotions associated with these environmental conditions (Buchanan et al., 2010; Thayer et al., 2012).

Emotions such as joy, serenity and calm, life satisfaction and higher self-esteem are therefore positively

related to vagal tone and HRV, compared to emotions of the opposite nature (Geislen et al., 2010, Martens at al., 2010).

In turn, cardiac vagal control is related to the bodily expression of emotions. There is in fact a link between the vagal control of the heart and the regulation of the striated muscles of the face and head and the intonation of the voice: their nerve pathways, not surprisingly, match.

Some studies on the acoustic characteristics of newborns' crying and their heart rate show, in fact, significant correlations from which it follows that vocalisations are a reflection of the vagal regulation of the heart (Stewart et al., 2013).

For that matter, Darwin, in his book on emotions in humans and animals, described the pneumogastric nerve as a nerve of extremely significant value, which connected the two most important organs of the body: the brain and the heart.

The myelinated vagal tracts are directly involved in the regulation of prosodic and vocalisation characteristics and of the expressiveness of the face; these are controlled by the same area of the brain stem that coordinates the vagus. Vocalisations and facial expressions are an important part of emotional communication.

The dysregulation of the myelinated vagus determines the loss of muscle tone of the upper part of the face and sometimes an increase in the tone of the lower part: the type of emotions that the individual will tend to be able to express changes, because the upper part of the face generally provides clues related to security, while the lower part is involved in the defence system (example: biting).

On the other hand, when the sympathetic activates mobilisation reactions, the range of emotions that can be expressed by the individual is greatly reduced, and the vagal tone is reduced (i.e., the amplitude of the heart rate oscillation beat by beat). In order for the balance to be shifted towards increasing the influence of the sympathetic, the influence of the vagal passages must be reduced.

By looking at a person, moreover, we are generally able to tell how they can feel; this happens thanks to their ability to transfer this information to facial expressions, but also thanks to our ability to read their emotions through the expression of the face and body in general. This is empathy, a fundamental human characteristic for social interaction, guaranteed by our neurophysiology (Theory of Mirror Neurons by Rizzolatti, 1996).

However, the signs of safety and threat are also conveyed by the vocalisation and prosody of the voice. These characteristics of the voice depend on the neural regulation of the muscles of the larynx and pharynx, and in particular of the tensor muscle of the vocal cords or cricothyroid, which is innervated by a branch of the myelinated vagus.

Therefore, through the face and the voice, we convey clues that are manifestations of what is happening to our body: we communicate to the other person how safe it is or not to approach us, if we are in a state of stress and reactivity, or if we are in a state of calm.

It is therefore evident, not only for Porges, that vagal activity and emotions are linked and that vagal regulation strongly influences emotional regulation. An interference in the process of vagal regulation could therefore generate disturbances of an affective nature or lead to misinterpretations of intentions.

If the upper part of the face, which, we repeat, expresses the signs of affectivity, is inhibited, if vagal control over the heart and face (which have the same anatomical origin) is blocked, one could encounter problems in social interactions due to the difficulty in interpreting emotional responses.

PLAY AS A NEURAL EXERCISE

Play is a behaviour common to all mammals, especially during the development phase. This has led the sociological, psychological, and pedagogical community to question the meaning of this behaviour, so important as to be common to many species and, in particular, to be extended, sometimes, as a practice, to adulthood. Let's consider humans and sport.

The importance of play is generally in the adaptive training function of the fight/flight ability. This vision is reworked with the Polyvagal Theory, which reinterprets play on the basis of the activation hierarchy of autonomic states and vagal pathways.

In this perspective, the primary function of play is no longer to prepare for hunting or combat, but to train the transitions between physiological states.

Play becomes, according to Porges, an authentic neural exercise, which simultaneously modulates the activation of mobilisation reactions, the inhibition of mobilisation and the system of social involvement.

"The difference between fight/flight reactions and play - writes Porges - is that in play, while we are mobilising, we also have eye contact and we are engaging with each other. We are dispersing the cues of threat through social cues, in order to use the sympathetic nervous system to support movement without resorting to defensive fight flight behaviours. When we call into question the system of social involvement, we can also use the oldest defence system, that is immobilisation, and we can still find ourselves in someone's arms, without feeling in danger, but feeling safe."

In fact, in play the individual produces reactions that can be either fight or flight, however the face-to-face interaction, a distinctive feature of play in mammals, allows the interaction system to read in the other (in facial expressions, or in vocalisation where direct eye contact is lacking) clues of security, recognising that the intention of the other's movements is not a source of danger or damage.

The message of the absence of danger reaches the most recently evolved vagal component, the system of social involvement, which will modulate the activation of the sympathetic nervous system, containing it. It is an exercise of reciprocal co-regulation between the individuals who face each other, capable of training the self-regulation of the ANS (emotional and behavioural).

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The official journal of the European Weightlifting Federation

MOTOR COORDINATION AND LEARNING THE TECHNIQUES

BY VITO LEONARDI

An enormous multi-articulated mechanical arm assembled the body of a car in a production line. It lifted, rotated on itself and fixed welding points at regular intervals with absolute precision while others of its kind assembled various components in perfect harmony with each other.

This is what I observed in admiration during a TV programme one evening some time ago.

Ah, I thought, if only human movements could have such constant precision!

Of course, I realised that it is not possible to consider the human body simply as a system of levers and controls in view of a high-performance action. A purely mechanistic vision would lead back to an outdated Cartesian body-mind dualism.

Human motility is not only aimed at a strategic result, but it is also the means through which the unity of expression is elaborated, a moment of exchanges and symbolic correspondences between different linguistic codes such as gestures that generate a physiognomic sub-level.

However, we can resort to the laws of physics to analyse the external aspects of human movements since these are subject to them, as such laws cannot be violated.

But biomechanics can only indicate what happened and provide optimisation criteria, as long as the functional motor assumptions exist, they cannot tell the history of how they happened, which refers to numerous interactive phenomena on the control and motor organisation of action and therefore provide only a certain model. Yes, a model because there are no two athletes in the world who run or jump in the exact same way in terms of joint angles, direction of thrust, parameters that vary each time even significantly in the same individual between one performance and another.

This model, however, is important: "Without a model of the optimal technique of a sporting exercise, we can only understand a part of it" (P. Tschiene, 84).

Thanks to the most recent simulators, in this regard, cybernetic mathematical procedures have been developed obtained from observation through special algorithms introduced into a computer that transmit the most important data, decisive for the sporting result - height, length, trajectory - and then study the effects which can be achieved by modifying them.

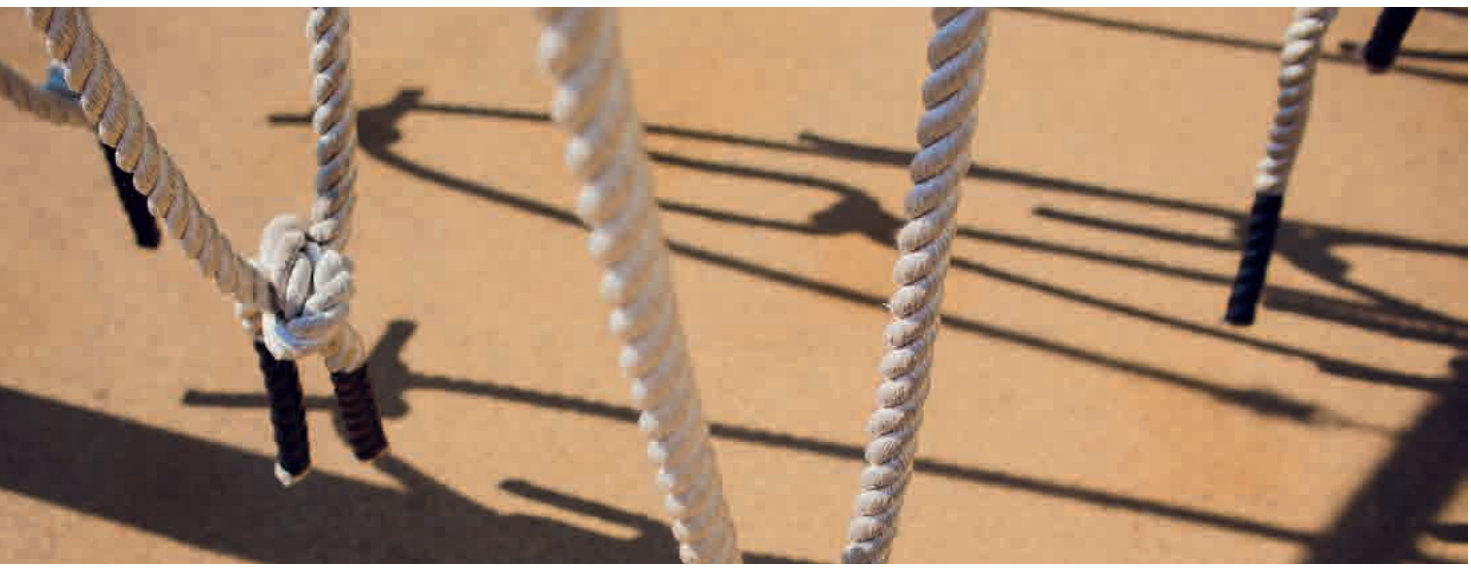
Records, I thought, are set in the field, "it is not possible to reproduce the real competition conditions in the laboratory nor to isolate the parameters to be analysed from all the surrounding variables" (by Prampero, SdS 84 no. 3, p.7).

An article by P. Bellotti and Y. Verchosanskij from 2000 came to mind: "Theory or practice in learning motor coordination?"

"Sport must deal with motor coordination ... to be performed in the best possible way, it must avoid any involvement of advanced algorithms from the cybernetic perspective that aims at the technological reproduction of human and animal movement and elevates practice to a paradigmatic referential place". (1)

A decidedly difficult undertaking, at least to date, due to the countless factors that contribute to it and their concurrence, one capable of altering the others in a completely unpredictable way such as the summing effects of different stimuli induced by physical exercise.

In short, a sum of stories that is not necessarily a mathematical sum (2).



WHERE DO THE MOVEMENTS COME FROM?

Firstly, the so-called conditional, organic-muscular abilities cannot be completely separated from the processes of motor coordination that are more of a neurological-psychological nature. The multitude of studies produced by sports researchers and scientists have increasingly tended towards the energetic factors of motor value and less towards those more related to the phenomena of execution.

What neurological, psychological, biomechanical approach to attempt and how much to aim for a synthesis of the whole?

We neither have a unified theoretical model nor are we able, even today, to explain and give solutions to the famous problem already posed by N.A.

Bernstejn regarding the substantial unsolvability of the control of human movements if not starting from the premise that we imagine it as a flow of stimuli nerves emitted from a central site, carrying information received to peripheral organs. (3) For Bernstejn, in fact, a movement cannot be conceived from a single impulse, but rather from the integrated action of inter-systems of impulses, which represent an uninterrupted function. (4) But that's too little, so we continue to rely on an experience-based didactic approach to convey informative messages for the execution of a motor task.

It is also clear that the problem of motor coordination presents itself differently between sports with multiple actions and those performed with a single action. In the former, the variety of motor expressions is very high due to the possible combination of several elements and the fact that they take place in conditions of absolute unpredictability.

But the difficulty of identifying a theoretical model of the regulation and control of movements is already inherent in the ambiguity commonly understood in the term coordination.

THE AMBIGUITY OF THE TERM COORDINATION

The frequent and varied use of the term has caused it to lose its original lexical matrix over time, making it synonymous with technique, ability, motor intelligence. In its etymology it indicates: "the act of ordering together, which assumes a "what" and a "how" according to a certain criterion".

It is evident that, in our case, we are dealing with movements (what) according to an order dictated by precision and performance (how).

At this point, the confusion with technique is already quite determined: what is technique if not the optimisation of several motor acts in view of the maximum utilisation of the athlete's motor potential?

Although in relation to each other, this optimisation is essentially achieved:

- in winning the greatest possible opposition;
- in expressing oneself with maximum speed;
- in expressing oneself with the utmost accuracy;

but technique and coordination are not the same concept. Can an action be technically perfect but coordinatively imperfect? Or vice versa, can it be well organised in the succession of movements but of poor performance?

In this regard, various definitions have been given, but all more or less indicate that motor coordination consists of:

- the adaptation of forces and duration of contraction of the agonist and synergistic muscles;
- the regulation of simultaneous and successive muscle contractions and the corresponding relaxation of the antagonist muscles;
- the constant adjustment of the accuracy of the movement through the game of balance regulating reflexes.

This regulation is carried out at the level of the double function of the muscle, the clonic function, which is the basis of the activities and the tonic function which keeps the muscle in a certain tension and supports its effort against the background of a postural accommodation that precedes the movement and allows any variation.

This possibility takes shape, to a substantial extent, in the context of situational variability and absolute unpredictability, a condition to which it is necessary to respond, with a highly intellectual tone.

This is only a transitive aspect of human motility, that is, in function of its effectiveness, with a programmatic, utilitarian nature, which does not immediately refer to subjectivity, to bodily expressiveness, to non-verbal languages, to the silent communication of the movement.

Regardless of the phenomena that underlie the motor act, human motility seems to present itself as a set of innate and acquired coordination. The former describes an instinctive motility genetically inscribed in all species suited to the needs of their conservation. In humans, they may correspond to the so-called "basic motor patterns" such as running, jumping, throwing, climbing, the simple detection of previous automatisms.

However, these need to be functionally developed and accommodated to a situation. For example, animals kept in captivity are unable to get food because they lack the necessary learning instructions, it is the phenomenon of imprinting for which these instructions must occur at certain times, beyond which learning is no longer possible and they cannot be returned to their natural environment.

At the end of the 1980s, R. Winter introduced the idea of the so-called "sensitive phases", ontogenetic periods during which there are favourable conditions for the development of certain motor skills, first and foremost, coordination. But is it a question of imprinting?

A great debate ensued. According to Winter, it is not possible to doubt that there are particularly favourable moments for the development of "certain qualities or classes of tasks", but what most deserves exploration is the internal dynamics of these periods which also favour the onset of shortcomings and mistakes. For example, it would be necessary to explain why over consecutive years we have been witnessing favourable and unfavourable moments, even in the absence of visible somatic transformations. For J. Bauer, (88) instead of talking about imprinting, not proven in humans, it would be a question of developmental pressures in relation to the different stages of maturation, so that it is clear that it is easier to influence maturing organic systems rather than already mature ones, also because these do not all evolve at the same time, first and foremost, the motor centres that involve the coming into play of the pyramidal system which is realised according to the embryonic laws of cephalo-caudal and proximal-distal development.

At present, however, there is the general agreement that innate coordinations need to be educated before other performance factors. Adjustment to a situation may not be immediate or automatic. The function of a new system of responses and a new structure is imposed.

INNATE AND ACQUIRED COORDINATION

These represent a truly complex plot to interpret and describe.
Blume (81) indicates motor coordination as the product of innate coordination, referring, however, to a higher degree of conscious processing determined by mainly informative control processes and proposes to insert the concept of "motor control ability" alongside the concepts of learning and adaptation of movements as fundamental prerequisites for sports performance.

His now famous schema:

- the combination, association and dissociation of alternating and/or simultaneous movements on different levels;
- the ability to differentiate as a way of organising movements precisely and economically through the harmony between individual phases and the movements of body segments;
- balancing ability, in other words, the synergistic action of agonist and antagonist muscle groups for maintaining a position in static and dynamic conditions;
- spatial-temporal orientation ability, to change body positions in relation to environmental conditions;
- rhythm abilities, that is to associate movements with sound structures;
- the ability to transform movements, adapting them to sudden directional changes.

In other words, it is a question of intervening on innate coordinations in order to master them, which implies a first degree of conscious elaboration for the purpose of acquiring complex motor acts, i.e., systems of movements coordinated according to a result or an intention (praxis).

Harre (77), Meinel and Schnabel (87) summarise coordination skills into functional and special: the former as a product of a multilateral motor practice; the latter as a product of a sporting activity characterised by the possibility of variation in the technique of that discipline (open skills?). Starosta (95) integrates these classifications, proposing the hypothesis of a whole due to a sort of internal

dialogue between sensory and motor characterised by precision, the treatment of sensory information, a relevant selection, action dependent on the experience of the individual and/or their education in:

- praxis with a transitive purpose, purely utilitarian;
- praxis with desire for communication;
- praxis with an aesthetic purpose more cantered on formal quality than on precision.

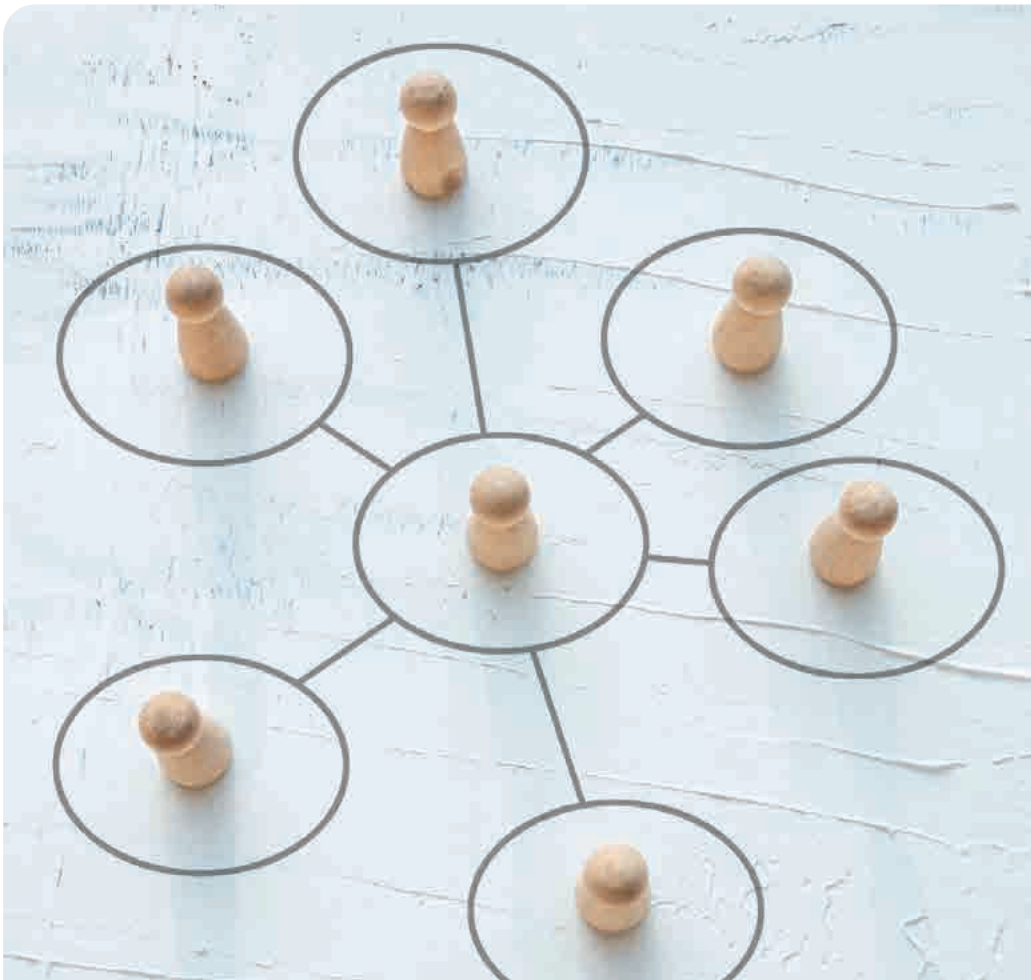
This subdivision is, however, only apparent since, in the end, even the purely aesthetic and communicative character of non-verbal languages in sport is codified and technicised.
Thus a style of bodily expressions emerge, a rhetoric of the body, of the technique of movements, capable of promoting the body as an apparatus of seduction with all the variations of time and fashions.
The synonymy existing between praxis, technique and ability inevitably leads to interpretative confusion and is often attributed the same meaning: systems of complex movements as a function of a result or an intention.
The prevalence of the result, and therefore optimising the action, leads in an initial analysis to the observation of what has occurred for the construction of a model which, as such, is always dissected and analysed in search of more effective solutions as far as they can concern directions of forces, corner openings...

It immediately becomes clear that the human aspect of movement is abandoned in favour of its mechanical performance characteristics.

On the other hand, it is not possible to analyse complex phenomena from a single angle. Where should we start? We take our cue from the fact that human and animal movement is a phenomenon of displacement in the surrounding world, ignoring, for the moment, to consider it as a need to relate to others, as a symbolic, aesthetic purpose and subsequent abstractions ranging from mimicry to gestural code. and whatever else. Therefore - whether we like it or not - human movement is born and develops between a clash of internal forces with external forces. Internal forces are produced by muscle contraction to move the body and/or part of it into the surrounding world. Muscles are nothing more than internal combustion engines that transform chemical energy into mechanical work. By the laws of physics, not all energy is transformed into work, but a loss in heat is inevitably produced due to friction, external and internal resistance, the latter due to intermuscular incoordination, from one muscle group to another and intramuscular, very difficult to be evaluated. The lower the heat dispersion for the same amount of energy spent, the higher the efficiency.

The external forces are due to the action of the earth's gravity and are studied in mechanics in the dynamic aspects, as regards the forces that produced the motion; kinematic, regarding the descriptive aspects independently of the forces that produced that motion; static, regarding the balance of the forces involved (5).

These laws cannot be violated and therefore internal forces will have to "come to terms" with the environment.



If internal forces prevail there is movement; if they are equivalent, the movement is null: but this does not mean that energy has been expended, since it will have instead been transformed into heat. If the internal forces are voluntary, the external ones produce involuntary effects: if you hang from a bar and raise your legs, you cannot prevent the pelvis from moving back so that the new centre of gravity is always on the vertical line. This mediation optimises movement for a compromise useful for the maximum realisation of the athlete's motor potential. According to this approach, human movements, and those of all living species, always take place through a play of forces, which constitutes the "spring" of movement.

In an attempt at the eupractic classification of technique as a synonym of ability, Capol and Walter (53) propose a 4-level classification, representing increasingly complex and integrated motor skills:

- the first level includes motor skills which are not strictly defined and adapted to a purpose, but which result from simpler and relatively automated movements. Numerous actions of our daily life belong to this category, such as shaving, writing ...
- the second level includes skills that are relatively automated as a whole and well directed to a purpose. This category includes a large part of the tasks entrusted to workers who, with a relative degree of exercise, can achieve a sufficient degree of coordination and automation of movements;
- the third category includes skills deriving from the association of several automated movements but closely linked to each other, as in composite sports where a succession of motor techniques are connected to each other to build a whole structurally united in a given form. What predominates is the automatism of succession;
- the fourth category includes skills deriving from the association of several automated movements without however being rigidly linked to each other but, as a whole, highly subordinate to the goal to be achieved, which is the reason for their coordination, but

in the application of which the intellectual element becomes part dominant to the point that as a whole they lose their automatic character. So that, although deriving from automatisms, they present such personal and particular individual characteristics so as to constitute the dominant and determining element of the awareness and development of intelligence.

It is clear that - in the above classification - other similar abilities can be found but when taken as a whole, they are referred to in literature as "closed and open", according to the references of development. The closed abilities are created in fixed environmental conditions, the environment does not change: for example: diving, athletics, gymnastics ...
The fixity of the concatenations is very rigid, a technical element revives, recalls the next hierarchically learned element and this gives rise to a well-controlled whole movement, but which still needs constant attention and vigilance.

Under these conditions, the action depends almost exclusively on psychosensory, proprioceptive information; the environment darkens and the attentive focus is turned to a dialogue between internal references often in a changing environment of external forces. These skills correspond to the third level in the above-mentioned classification.
The second, open skills, are realised in conditions of instability and absolute environmental unpredictability: team games, combat sports, also known as situation sports. The executive techniques are not strictly learned but each time adapted to the unfolding of events. The dominant information of execution and control are essentially psychosemantic in nature and then psychosensory in nature, gathering information about the meaning of what is happening, for example the understanding of opponents' feints and also an anticipatory vision of events. These skills are found in the fourth level of the aforementioned classification.
Over time, or with an increasingly refined acquisition due to experiential practice, these skills evolve inversely: "the closed open and the open close". As mentioned, in closed skills, concentration is at its highest at the beginning of the execution of the motor sequence, since the performance as a whole depends on this beginning and the attentive focus is more concentrated on listening to sensory information, perception of the surrounding world is blocked out. At a subsequent processing stage, the individual automatically "starts up" the motor programme and the attention becomes aware of external factors. The contrary occurs with the latter skills, where - at an initial processing level - attention is more focused, for example, on the manipulation of the ball than on what is happening around it. At a second stage of experience, the individual automatically elaborates the sensorial proprioceptive control of the object to draw clues from the evolutionary conditions of development. At a third stage, attention, control and vigilance return to the object automatically, so as not to provide the opponents with intentions and game tactics. Over time, the same game tactics more or less automate and close at the same time.

Are these skills really an expression of motor coordination or even of motor intelligence or rather automatisms that the more they are consolidated and specified the more they escape consciousness? (6)

SKILL, DEXTERITY, MOTOR INTELLIGENCE...

The terms, though varying, all interpret an operative motor modality capable of solving the unpredictable problem situation in the most effective way possible.

In sport these situations end up repeating themselves, they are expected, even if they always involve different solutions so that everything is not entirely new. Le Boulch (75) calls this ability dexterity (in the classification of A. Dal Monte, this term refers to composite sports), "which brings together the idea of an action to be performed in the same very short instant, a selection, a synthesis, a decision, a well-controlled act" and therefore undoubtedly an intelligent action adapted to reality, in several phases:

- a clear and immediate image of the problem situation;
- a concise and rapid overview of the obstacles and available means;
- a reaction and an activity commensurate with the idea that has been made;
- control and vigilant action on unexpected and sudden changes.

What is meant by intelligence and how it is more correct to define it has perhaps been the most debated question in psychology. Stafford and Binnet had already addressed the issue in the distant 1900s and

proposed tests to evaluate the IQ. A further refined scale, in 1916, by Terman Lewis Madison, evolved in modern tests seen in a relationship between mental age and chronological age multiplied by 100. In these tests, however, average values closer to academic performance and of a general nature are evaluated. In "Forma Mentis", Gardner (2002) proposes the idea of a pluralistic vision called the theory of multiple intelligences, rejecting a one-dimensional conception of the mind, in seven types of intelligence: linguistic, logical, mathematical, musical, spatial, corporeal, kinesthetic, interpersonal-intrapersonal and, a more recently addition, emotional. It is intriguing to note that in sports these are all strongly involved and connected. Kinesthetic corporeal intelligence involves spatial intelligence in the role of placing oneself in the game space, of constructing mental and forecasting schemas. Temporal intelligence is connected to rhythm, intra and interpersonal intelligence that include the sense of self whose identity is the condition of the constructive relationship with others, with teammates, with coaches.

A further contribution to the concept of the idea of intelligence goes even further than that of Piagetian memory that is described as the ability to solve problems, fundamentally anchored to the use of skills. Steinberg (85, 87, 2000) formulates a so-called "tripolar or tricassic" theory of intelligence through three fundamental modalities: analytical, creative and practical. Unlike analytic intelligence, as a comparison between different elements, creative intelligence is more linked to intuition, to the imagination in dealing with unusual situations for which the skills possessed are inadequate, in short, open to multiple solutions. And lastly, practical intelligence which includes the ability to use tools, planning, demonstration of know-how.

In conclusion, intelligence is expressed in the behaviour of the context in which it takes place, from the cognitive processes that underlie it, from the mediating experience between organism and environment (Marzano 2006), in a game where other individual factors, courage and determination combine with primary reactions, with the defensive reflexes, with secondary adaptive reactions made up of an intuition and a response, in other words, to the transitive aspects of motor behaviours.

THE TECHNIQUES WITH AESTHETIC PURPOSE

In this category we can find body techniques with a symbolic character, communication through a conventional gestural language.

Unlike a purely phenomenological vision, these techniques try to identify the "rules" that are the point of passage to a production of meaning through a codified system of movements that are technical yet possess a natural expressiveness, which is also studied, dissected, technicised.

In dance, gymnastics, synchronised swimming, the athlete is subjected to precise gestural rules, smiling, winking, directing one's gaze and also of make-up and clothing, capable of bringing together the necessary conditions for the production of differential differences of the signifier according to the which signification is formed to transform the body into an apparatus of seduction, of staging. The body narrates how that performance was overcome with agility and absolute mastery in spite of the difficulties and does not show the suffering behind the quest for perfection.

In brief: the intention of this work, drawing from the theories of various authors, is to outline a framework on the control and regulation of human movement independently of the neurological and psychological phenomena of learning.

In the first instance, in the so-called innate coordinations, motor adjustment is part of the genetic background of the different species and corresponds to instinctive acts capable of relating to the environment and which are realised thanks to the existence of pre-existing functional structures. In man, these are basic motor patterns: running, jumping, throwing, rolling ...

In multi-stage acquired coordinations, innate ones are not directly adapted to external conditions; in their development, hereditary factors and the influence of the environment are constantly blended through the phenomena of learning. According to this interpretation, the mastering and reworking of innate coordination correspond to a first stage, according to the Blume scheme, that is, in the dissociation and association of movements, in maintaining balance in transformation, in adaptation, and they constitute the most important premises for increasingly refined specific technical acquisitions. They have a transitive purpose, that is, in function of a result, defined praxes in the neurological field, but also with the term skills and conduct in the psychological field with the meaning of action planning.

Stabilisation through repetition makes performance a series of automatic action as the final product of learning.

Since motor actions are subject to the laws of physics no matter what, the biomechanical interpretation arises in the first instance as a model and, as such, adapted to individual variants for the maximum utilisation of the motor potential of the athlete. For biomechanics, walking on a balanced axis at 50cm or 10m makes absolutely no difference.

Depending on the degree of difficulty, skills are classified into several eupractically connected categories, the more marked they are, the more the concern about risk and performance.

A further distinction between closed and open skills: the former are achieved in conditions of environmental stability, they are rigidly fixed at an evolutionary level but also difficult to "alter"; the latter, on the contrary, which occur in conditions, albeit similar but never the same and unpredictable. The intellectual element becomes the dominant part so as a whole they lose the nature of pure automatisation and open up to the concept of motor intelligence.

MOTOR REGULATION AND NEUROLOGICAL DATA

The idea submitted by Bellotti P. and Verkhoshansky Y. (2000) of favouring a theory of motor coordination in a biological and not a purely cybernetic sense leads inevitably to consider not only the neurological phenomena that underlie it but also those connected to the pedagogical context that it involves all the activity of learning, improvement and correction and therefore, the didactics of teaching. Bernstein N.A. (1935) had previously recognised that an unequivocal relationship between nerve impulses and movements does not exist and cannot exist since these are defined by extremely variable interactions of motor signals at the level of the CNS, therefore more than one motor signal can lead to the same trajectory, but also to different movements [an interesting reference to a phenomenon that no one seems to take into account, among the so-called movement experts who operate - so to speak - in the world of physical exercise and sport, ed. note]. Therefore, if on the one hand the same nerve stimuli can lead to different movements and vice versa, redundancy, and on the other hand perception to different interpretations of the observed reality, the problem of motor coordination in its entirety is widely indeterminate. This means intervening on an uncontrollable system to make it controllable: it is the phenomenon that has historically been defined as "The Bernstein's problem".

In the literature about this phenomenon there are many works that debate the problem of motor coordination. These studies develop in different directions for the foundation of a causative theory that provides a rational explanation, which allows to solve problems of learning control: "currently the problem of motor coordination appears as a dissociation between theory and practice in which the theory today not only succumbs but does not even find citizenship status" (Bellotti and Verkhoshansky, 2000).

Despite numerous studies and the contribution of scholars who have dealt with learning, techniques and teaching, a holistic understanding of the problem still eludes us.

Neurological interpretation immediately poses a problem: the brain as an organ and as the mind, what correlation is there? In a neurological examination, currently at least, we are unable to distinguish the brain of a madman from that of a normal individual and even less from that of a scientist.

As far as the motor aspects are concerned, human motility is much more complex to interpret than that of other species, which is more instinctive and genetically predetermined for conservation. Perhaps man truly became sapiens when for the first time he stepped outside the box to undertake a "freely" voluntary action as discussed by Popper with Eccles in "The Self and its Brain" one being a believer and the other an atheist, where the second freely attributed something divine to the term.

We do not know if there is a divine intervention in the evolution of the human brain, but we do know that this organ has developed at several integrative levels of nerve formations according to an order in which the most recent brain structures always exercise a dominant role over those more primitive (Jackson's principle).

According to this principle, different levels of functionality are outlined, equally representative of the different degrees of the zoological scale up to the human being, where these appear increasingly complex and differentiated at five levels:

1) the spinal level
2) the cerebellar vestibule level
3) the striated thalamus level
4) the motor cortical level
5) the associative cortical level.

1. The first level presides over the actions of reflexes and constitutes the basic functional activity of the central nervous system and is also unique in the primitive forms of vertebrates where it constitutes the maximum possible integration. The impairment in humans is called areflexia, that is, the loss of automatic reflexes.
2. The second level is cerebellar which appears in amphibians that need to adapt to terrestrial life and require structures capable of ensuring their balance and stability. Its impairment in humans is called ataxia, it manifests itself with difficulty in maintaining an upright position, swaying like drunk when walking.
3. The third level is the striated thalamus, it presides over the functions of motion primarily of an automatic type and finds its highest level in birds in which very little cerebral cortex is found. Flight is therefore a striated thalamus function.
4. The fourth level is the motor cortex, which appears in mammals in which the primitive brain is covered with cortex which will then progressively extend to give rise to the great spinal cortical pathway. And it is precisely from this that, starting from mammals, the motor order destined to be completed with the spinal one, in other words, the lowest level, is imparted.
5. The fifth level, the associative cortical, is instead the typically human one which allows fine and discriminative motor activities in which the movements rise to both kinetic and kinesic connotations, communicative of non-verbal languages.

In humans, the previous levels are not suppressed but integrated with and controlled by the higher ones. The cerebellum, which is the anatomical formation responsible for defining many details of movement, also responsible for mediating feedback systems, when information comes from the sense organs through their channels. However, the organisation of the NS, with its afferent and efferent pathways, involves another type of response to external stimuli: reflexes. By virtue of these, instantaneous adaptations to peripheral excitations are made and complex and synergistic movements result. This game, which follows an order and a hierarchy which the higher centres preside over, testifies to the integrative capacity of our CNS.
The cerebellum, as mentioned, provides authentic advice on the motor programmes of the cortex, which is mandatory, since the brain cannot initiate any action without the cerebellum being already informed through the numerous connections that branch out through the two hemispheres.

The motor idea, supervised and compared in its own memory, is retransmitted after further informative processing coming from the different sense organs, so that each action is generated in the perception-cognition-action sequence according to its own primary neural substrate, for which the final result is a perceptual synthesis not always a copy of reality, but a fantastic interpretative elaboration.

In this regard, various theoretical models have been formulated that

are affected by their era and fertilised by cognitive psychology, physiology and, more recently, by neuroscience.

At the base of more neurological models is a particularly effective perceptual nervous organisation, connected with the movement analysis centres, but also supported by physical requirements of an executive nature.

In the 1960s, Pribram K.H., Miller G.A. and Galanter E. formulated the theory of cognitive maps, i.e. recorded programmes of movements based on a hierarchical structure of motor patterns allowed and mediated through feedback mechanisms: clearly behaviourist thinking. Choutka's model, cited by Malho (1969), also bases its legitimacy on purely physiological assumptions: perception, analysis, choices-responses, three phases which almost correspond to the pattern of the reflex arc!

Perception is most certainly realised through the sense organs, but these produce perceptive syntheses given the enormous number of information that reaches the analysis centres, syntheses that account for the different degree of attentional processing, a set of operations, recognition, of representations and point of passage of the brain as an organ and as a mind.
Nebioth M. (82) distinguishes two types of information:

1. unsolicited information concerning the physical characteristics of the stimulus, visual, acoustic;
2. solicited information, linked to the store of possible hypotheses from the evolution of the situation.

But due to time limits and high uncertainty, it is possible to perceive only what is actively sought, so the analysis of perceptual activity depends on the forecast hypotheses, to anticipate future events. Recently, a study developed at the University of California at Berkeley by a group of researchers using the Electrocorticography method, published in "Nature human behavior" (2017) showed that some areas of motor response are activated very early on, already during the stimulus, suggesting that - even before the motor input has been processed - the brain alerts the output areas so that they are ready for action. But is it expected information or reflexes? The orientation of attention, as Eriksen Yen suggests, leads to the comparison of attentional processes such as a zoom lens model, along a continuum that goes from focused attention to widespread attention and vice versa: the more attention is diffused, the lower the precision, a process that improves with lived experience, as a result of a psychic activity that allows the representation of both an environmental and a control situation (Schubert F., 1990).

PERCEPTION AND ACTION

The difficulty of a mental representation of the task to be performed is determined first of all by the characteristics of the sequence, for example acrobatic sequences involving perceptual, vestibular disturbances, risk conditions (gymnastics, diving), by the amount of information to be treated, difficulty that increases linearly according to the logarithm in base 2, by the number of alternatives, a, of equal probability between correct answers, P1, and wrong answers, P2, according to R.W. Pew's formula (1969):

$$a + \log. P1 / P2$$

With experience and the automation of the task, the probability of incorrect answers is reduced.

In closed skills, proprioceptive perceptions are the cornerstone of learning and performance. There is no environmental unpredictability other than those determined by one's own execution errors but in the end these too are foreseen in the connections of the various elements that make up the entire sequence. The temporal dimension also follows a chronological order that can be neither anticipated nor delayed.
Everything takes place starting from a voluntary input, as already mentioned, to "broadcast" a series of automated motor techniques also in connection with each other; attention control is very high especially at the beginning.

This hierarchical, mechanised automation becomes almost independent over time from a higher voluntary control, so much so that it constitutes an obstacle to intervene in executive and improvement details, as a phenomenon of an internal organisation in which the thinking brain needs to download the details of execution to undertake higher control and supervision activities. These stereotyped learnings are still and always the object of criticism by psychologists and pedagogists; they refer to the idea of

the body as an object and objectified to the laws of performance. In a statement by Le Boulch J.P. (1975): "the perfection of automatism is not in the fixity of its muscular concatenations, but, on the contrary, in the possibility of reorganisation at each instant of its execution and in the course of subsequent movements", remains a chimera as well known in practice, or at least an idea closer to physical education than to that of competitive sport. Unlike in open skills, however, in closed skills the precision/speed decision-making conflict does not arise in constraints of time limits, in which the difficulties are all the more marked the more limited is the time granted to the motor response. As shown by Robillard A.C. (1979), this necessarily implies that time required, and time allowed are on an axis of choice between speed and precision. "The athlete either treats the information completely, risking significantly cutting the time required for execution, or quickly triggers a response, running the risk of inadequate action" (Rippol H, 1989).

The informative decision-making dependence in this framework can lead the athlete more to being informed rather than actually deciding. This represents only a first stage of sporting mastery, subsequently the athlete will be more able to anticipate future events as the main organising agent from information he/she has acquired by evoking second and third intention strategies. This status of active operator requires the planned intervention of probabilistic events aimed at the optimal solution of the strategic action, pre-prepared actions but which can also automated even if elastically.

These complex processes in the literature of contemporary psychology are indicated by the terms resilience and coping which interpret motor strategies of an adaptive type thanks to positive personal-relational experiences through the past-present-future in the perspective that the individual and the environment operate in producing forms of adaptive-maladaptive functioning. Coping implies an evaluation, both of the event in order to understand its consequences, and for the effects of the answers given.

In literature, different coping modes are identified: one centred on the problem, focused on finding a solution but oriented by emotions, aimed at overcoming the negative ones, another on activities (Iavarone ML, 2008). The interpretation between the different elaborative states resorts to a continuous process of representations, which leads to a flexibility which calls into question the tactical schemes programmed for teaching based on adaptability to situational fluctuations, but always requires a motor vocabulary of ability. In brief, executive difficulties appear from a set of factors:

- the time required for implementation
- the number of movements requested
- the number of variability of possible answers
- the degree of automation
- as well as the importance given to the competition and the presence of others.

All this involves a cost, not only of a muscular energetic nature as an external load, but also an internal one of coordinative fatigue due to an inhibitory increase or decrease of the cerebellum, whose main role, as previously mentioned, is that of anticipation even before the execution itself. This cost can be very high in precision and/or high-risk sports.

THE ROLE OF MIRROR NEURONS

The mechanisms underlying intelligence and behaviour constitute a multidisciplinary research field that welcomes contributions from physiology, cognitive sciences, psychology and even artificial intelligence.

Embodied cognitive science aims to explain the internal mechanisms in order to arrive at a theory of cognition considering that corporeality constitutes a necessary condition for cognitive development. According to this theory, every form of cognition is always deeply anchored to the body thus giving scientific confirmation of the outdated Cartesian dualism and of the first cognitivism based on the idea that the processes of cognition were exclusively mental acts. On the contrary, even the most abstract human activities are actually transformations of the simplest bodily activities (Iavarone ML, 2016, Abitare la Corporeità, acd).

Towards the end of the 1990s, the discovery of mirror neurons corroborates the theory of embodied, due to the fact that these contribute to creating an idea of movement, an internal representation that is free from execution. Located in the premotor cortex in the parietal lobe, they show a close link between visual and motor responses and seem to indicate that the observation of other people's motor acts activates a potential for internal representation. Not that this was not known in practice, previous observations had already found that observation was the best means of communicating the executive model and that only bodily experiences can provide clues about perceptions to be taken into consideration. However, for a concrete realisation, other conditions are necessary that refer to the possessed motor patrimony.

The discovery of mirror neurons in fact, reformulates that the motor areas of the cerebral cortex are always associated with operational and cognitive functions and therefore of a higher order that find legitimacy in a primitive neural substrate.

Further studies of mental chronometry and brain imaging indicate that real and imagined movements are functionally similar and that, in both imagination and execution, the same brain areas are activated, from the spinal ganglia to the cerebellum, so the observed action is also motor image. But the execution cannot be the result of simply thinking knowledge; watching birds fly is not a first step to flying!

However, these studies open up to didactics scientifically based on neuronal mechanisms. Is this the model of the future advocated by Bernstein N.A.?

We are living in the "century of the brain" and the media tell of scans that show how specific areas light up to certain stimuli, but understanding a single neuron or a population of neurons is not enough to explain how these interact with each other in a integrated totality, an "emergent" property as defined by Yuste R. & Church GM (2014) about consciousness, just as, for example, a multiplicity of atoms and molecules emerge from the temperature of a material, a property that does not depend on individual atoms but on their interactions.

Achieving a scientifically based theory on the control and regulation of movements for a pedagogy of teaching also means arriving at a theory of conditional training, both to be considered laws of adaptation, and therefore a theory of everything. And this is also the dream of scientists who are concerned with the laws of physics. Einstein himself tried throughout his life to unify his famous theory of relativity with quantum field mechanics, an area in which he himself had made a valuable contribution without much success and still today the theory of the infinitely large and the infinitely small if although both demonstrated, they do not connect to each other in a coherent overall picture.

But does the equalisation between physical and biological laws make sense, between the physical universe and the cellular universe capable of describing matter at different levels of functioning between organic and inorganic?

Are we not made of matter and this is made up of atoms in turn made up of electrons, protons, neutrons, quarks?

Isn't it amazing that matter is able to think and question itself?

I was thinking...

Meanwhile, the car was leaving the production line, completely assembled, to be stored in a parking lot.

It's late and I'm going to bed.

NOTES

1. The term cyborg, cybernetic organism refers to the idea of an enhanced human organism that was also the leitmotif of the cyberpunk trend of the 80s with the films Terminator (1984) and RoboCop (1987). Robotics is a branch of engineering and, with the development of neurorobotics, a science involved in the design of artificial limbs.

2. The concept of the number of stories was the brainchild of physicist, John Wheeler, to define the evolution of a probabilistic system that takes the name of path integral. If a thrown stone follows a trajectory that depends on the competition between kinetic energy and potential energy and is the only possible one, in the quantum world this obligation no longer exists, and all possible paths or stories contribute to determining what happens. Therefore, the action maintains a fundamental role but the information obtainable from the evolution of the system becomes probabilistic.
3. According to the traditional theory, the nerve signals are transmitted in the membrane of the external wall of the axon allowing sodium and potassium ions, electrically charged particles, to pass through it. Recently, physicists Heimburch T. and Scheheider M. have argued that in reality the signal is a mechanical and non-electrical impulse that propagates as a wave along the axon and similar to a seismic sound wave (Douglas F., Le Scienze, 06, 2018, 66-71)
4. See Bernstein's, "The Physiology of Movement", Sports Press Society, Rome, 89, 98-103
5. Forces do not balance simply because they are applied, they balance their moments.
6. A shared theory is still lacking in the definition of consciousness; two interpretations are compared: the Global Workspace Theory (GWT), the theory of the workspace proposed by neuroscientist Baars B. according to which human brains are structured around a workspace similar in this to a working memory. The other, the Integrated Information Theory (IIT), or theory of integrated information originally proposed by the neuroscientist Tononi G. on a mathematical basis. Both are considered candidates for a coherent theory of consciousness (Blackmore S., The Mystery of Consciousness, Le Scienze, 11, 2018, 45-49).

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VITO LEONARDI

A graduate in Sports Science and former professor at the College of Physical Education in Naples and at the "Parthenope" University of Naples, Mr. Leonardi collaborated with the "S. Antipolis" University of Nice. An international gymnastics referee, he has held numerous positions in the Italian Gymnastics Federations and collaborated in the drafting of the training programmes. Director of the Regional School of Sport in Campania from 2002 to 2008, he is currently a national lecturer and President of the Campania Regional Committee of the Italian Weightlifting and Physical Culture Federation.
He has published four books and numerous papers in federal technical journals and has been a speaker at numerous congresses.

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Spanish resumenes

IMPACTO DEL ESTRÉS, INMUNIDAD Y SEÑALES DEL SISTEMA ENDOCRINO Y NERVIOSO EN LA FASCIA
Nicola Barsotti, Marco Chiera,
Diego Lanaro, Massimo Fioranelli
SM (Eng), nº 16, año VI, págs. 4-32
La respuesta al estrés, en virtud de la liberación de glucocorticoides y catecolaminas y mediante la modificación de las respuestas endocrina, neuronal e inmune, puede afectar a la función de los fibroblastos y miofibroblastos presentes en todo el cuerpo y más concretamente a la fascia, un tejido conectivo ubicuo y multifuncional que da soporte al cuerpo. En este artículo analizamos estas respuestas inducidas por el estrés que dependen de la psiconeuroendocrinoinmunología.

CRECIMIENTO EN ESTATURA EN JÓVENES LEVANTADORES DE PESAS OLÍMPICOS
Marco Cutillo
SM (Eng), nº 16, año VI, págs. 34-39
El Autor ha llevado a cabo un estudio para demostrar que los chicos y chicas practicantes de Halterofilia Olímpica disfrutan de un proceso constante de crecimiento en estatura, al igual por no decir superior al de los demás coetáneos examinados, sedentarios o practicantes de otros deportes, desmintiendo así los temores, a menudo invocados, de un posible "bloqueo del crecimiento".

TEORÍA POLIVAGAL, COGNICIÓN CORPORIZADA, PERCEPCIÓN-ACCIÓN
La Teoría Polivagal y el papel de la seguridad: autorregulación y corregulación emotiva y conductual en el juego.
El proyecto: "Vag-ando con las emociones"
Antonio Mazzoni, Maria Pia Albanese,
Annarosa Caradonna
SM (Eng), nº 16, año VI, págs. 40-51
Gracias a la aportación de la neurociencia, el artículo pretende demostrar cómo el juego permite desarrollar experiencias psicofísicas complejas, cambiar la red de las conexiones neurales, centrales y periféricas y reorganizar las huellas de las experiencias vividas, incluso de las relacionadas con experiencias desagradables y/o traumáticas. El juego, tanto en su dimensión intrapsíquica como interpersonal, tiene la capacidad de modular y corregular, en relación con el otro, los estados internos de los participantes. La teoría Polivagal de S. W. Porges, la terapia sensoriomotriz de P. Ogden, la teoría del apego de M. Ainsworth y de J. Bowlby, la filosofía del okness de Stewart y Van Joines, la teoría del Cerebro Triuno de MacLean, la teoría de la Regulación del afecto de A. Shore y la teoría de las neuronas espejo de Damasio, son las bases de referencia con las cuales se realiza el proyecto psicomotor "Vag-ando con las emociones", cuyo objetivo es favorecer el desarrollo armonioso del niño en el entorno de un contexto experimental, relacional, afectivo positivo e inclusivo también de la discapacidad. Por consiguiente, el juego, es considerado cómo dimensión evolutiva, creativa y reparadora irrenunciable para el crecimiento sano y armonioso del individuo.

COORDINACIÓN MOTRIZ Y APRENDIZAJE DE LAS TÉCNICAS
Vito Leonardi
SM (Eng), nº 16, año VI, págs. 52-67
Se trata de un ensayo repleto de datos sobre la coordinación motriz. El Autor recurre a los conceptos básicos y los ilustra de una manera original: ¿qué es la coordinación motriz? ¿Qué reflexiones nos suscita? ¿Qué significa en realidad y cómo se expresa? Las coordinaciones innatas y las adquiridas, la habilidad y la destreza, cómo interpretar la inteligencia motriz, el sentido de las técnicas con un propósito llamémosle estético, también afronta los temas de la regulación motriz y los datos neurológicos, de la percepción y de la acción, del papel de las neuronas espejo en la coordinación de los movimientos.

The official journal of the European Weightlifting Federation

Russian resumenes

ВЛИЯНИЕ СТРЕССА, ИММУНИТЕТА И СИГНАЛОВ ЭНДОКРИННОЙ И НЕРВНОЙ СИСТЕМ НА ФАСЦИИ

Nicola Barsotti, Marco Chiera, Diego Lanaro, Massimo Fioranelli

Реакция на стресс, за счет высвобождения глюкокортикоидов и катехоламинов и изменения эндокринных, нервных и иммунных ответов, может влиять на функцию фибробластов и миофибробластов, которые находятся во всём теле, а точнее, в фасциях, речь идёт об очень распространенной и разнобразной реакции функциональной соединительной ткани, поддерживающей тело. В данной статье рассматриваются реакции вызванные стрессом, опираясь на достижения психонейроэндокринной иммунологии.

ЕСТЕСТВЕННЫЙ РОСТ ЮНЫХ ТЯЖЕЛОАТЛЕТОВ-ОЛИМПИЙЦЕВ

Marco Cutillo

Автор реализовал исследование, с целью чтобы продемонстрировать, что у мальчиков и девочек, занимающихся олимпийской тяжёлой атлетикой, наблюдается процесс постоянного естественного роста на том же уровне, если не выше, чем у других обследованных сверстников ведущих сидячий образ жизни или занимающихся другими видами спорта, тем самым отрицая часто возникающие опасения потенциального «блока роста».

ТЕОРИЯ ПОЛИВАГАЛЬНОСТИ, ВОПЛОЩЕННОЕ ПОЗНАНИЕ, ВОСПРИЯТИЕ-ДЕЙСТВИЕ

Теория поливагальности и роль безопасности: саморегуляция, эмоциональная и поведенческая совместная регуляция. Проект: «Блуждая с эмоциями».

Antonio Mazzoni, Maria Pia Albanese, Annarosa Caradonna

Цель статьи заключяется в том чтобы проанализировать, на основе достижений нейробиологии, как игра позволяет получать участникам сложные психофизические переживания, изменяя сеть нейронных связей, как центральных, так и периферийных, реорганизуя следы опыта жизни, даже те, которые связаны с неприятными и/или травмирующими переживаниями. Игра, как её интрапсихические так и в межличностные измерения, обладает способностью модулировать и вместе с тем регулировать, через взаимоотношения с другими участниками, внутреннее состояние игроков. Поливагальная теория С. В. Порджеса (S. W. Porges), сенсомоторная терапия П. Огдена (P. Ogden), теория привязанности М. Эйнсворта (M. Ainsworth) и Дж. Боулби (J. Bowlby), философия нормальности Стюарта и Ван Джойнса (Stewart e Van Joines), теория Триединого мозга Маклина (MacLean), теория регулирования аффекта А. Шора (A. Shore), теория зеркальных нейронов Дамасио (Damasio) являются эталонными матрицами, в рамках которых осуществляется психомоторный проект «Блуждать с эмоциями», направленный на содействие гармоничному развитию ребёнка в рамках эмпирического, относительного, аффективного и положительного контекста, включая инвалидность. Таким образом, игра рассматривается как эволюционное, творческое и восстанавливающее измерение, необходимое для здорового и гармоничного роста человека.

ДВИГАТЕЛЬНАЯ КООРДИНАЦИЯ И ОСВОЕНИЕ ТЕХНИКИ

Vito Leonardi

Речь идёт об эссе, богатом данными о координации движений. Автор возвращается к анализу основных понятиий, которые иллюстрирует используя оригинальный подход: что такое координация движений? К каким размышлениям она нас приглашает? Что это на самом деле означает двигательная координация и как она выражается? Врожденная и приобретенная координация, навыки и ловкость, способы интерпретации двигательного интеллекта, чувство техники с так называемой эстетической целью. Автор также затрагивает вопросы регуляции моторики и неврологических данных, восприятия и действия, роли зеркальных нейронов в координации движений.

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