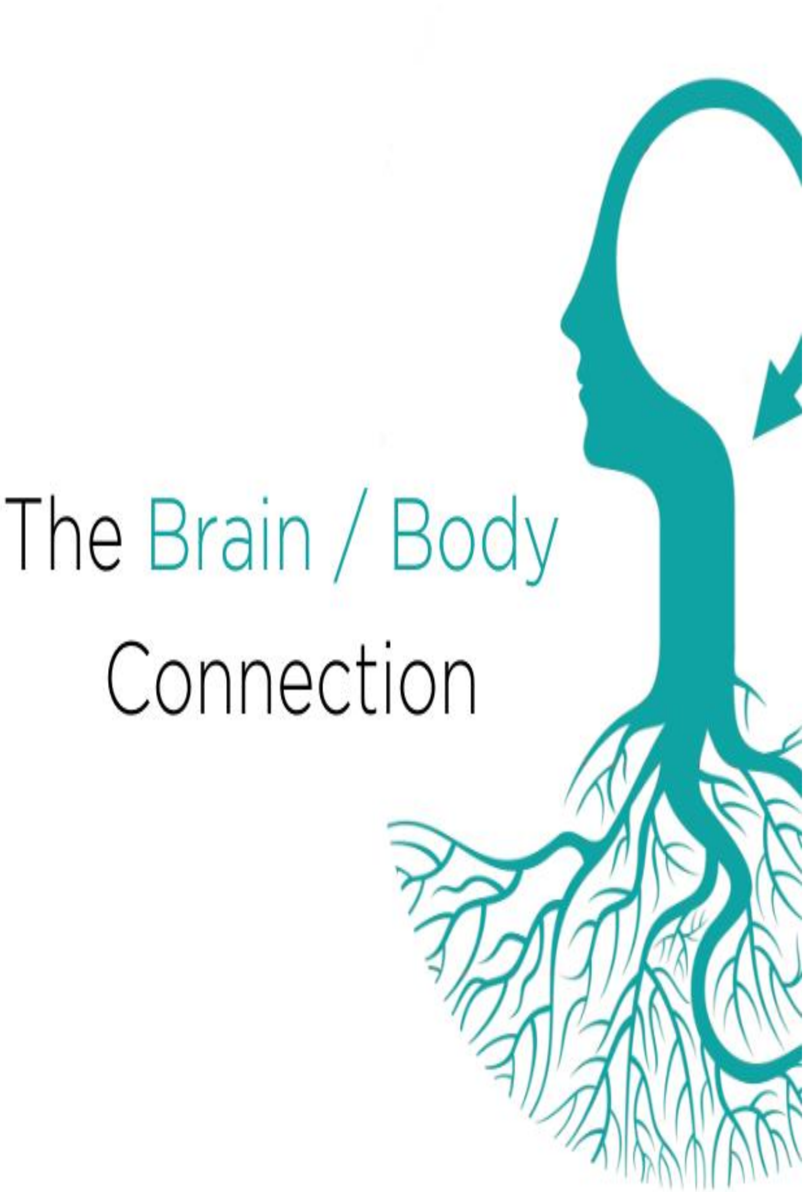
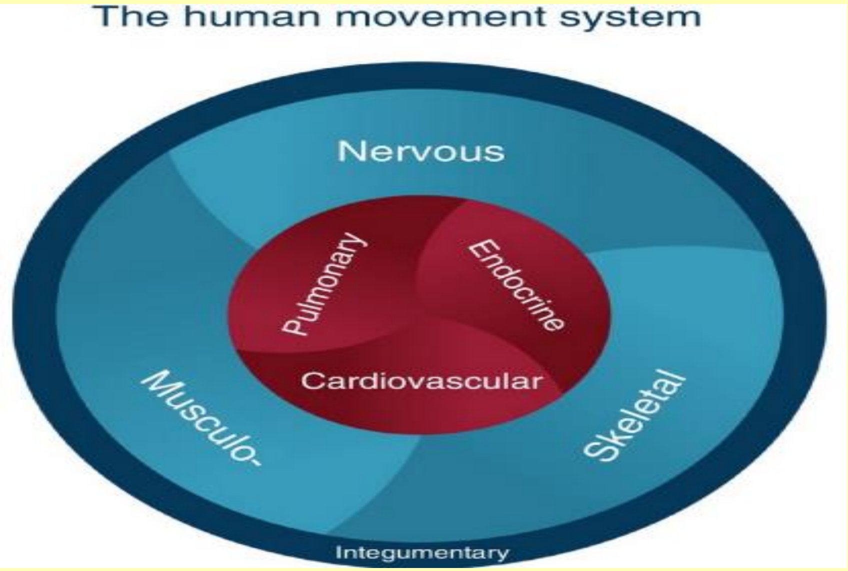


- M.SC. of Sport Injuries and Corrective Exercise.
- Researcher neurofeedback training.

- The sport injury rehabilitation process starts with the occurrence of the injury.
- In sports injury prevention and prediction research, several theoretical models based on physiological and biomechanical factors in the field of sports injury research have been presented.
- In the field of treatment, several protocols have been proposed that typically focus on the physical aspects of sports injury.



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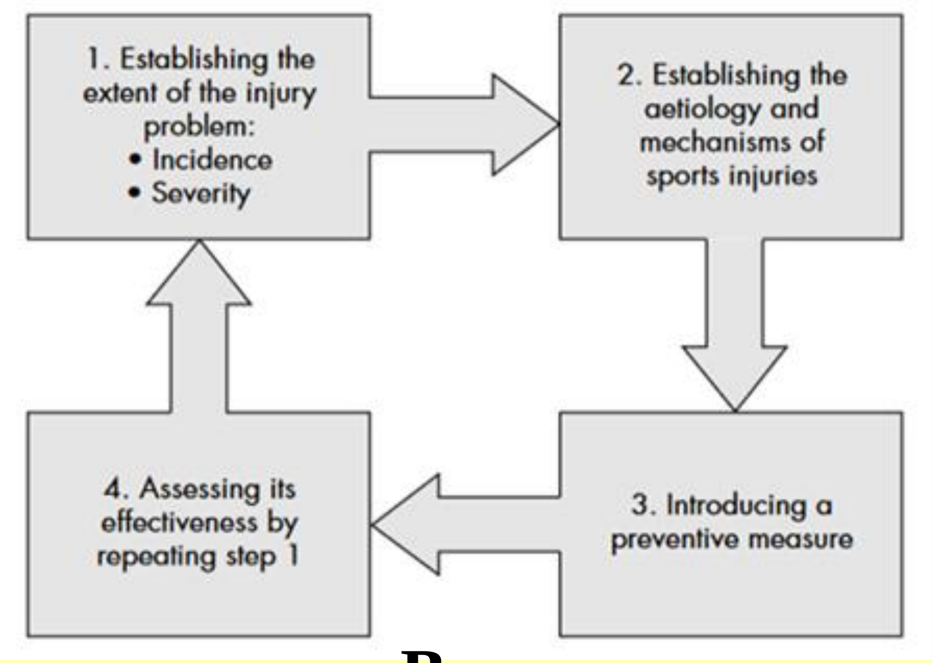


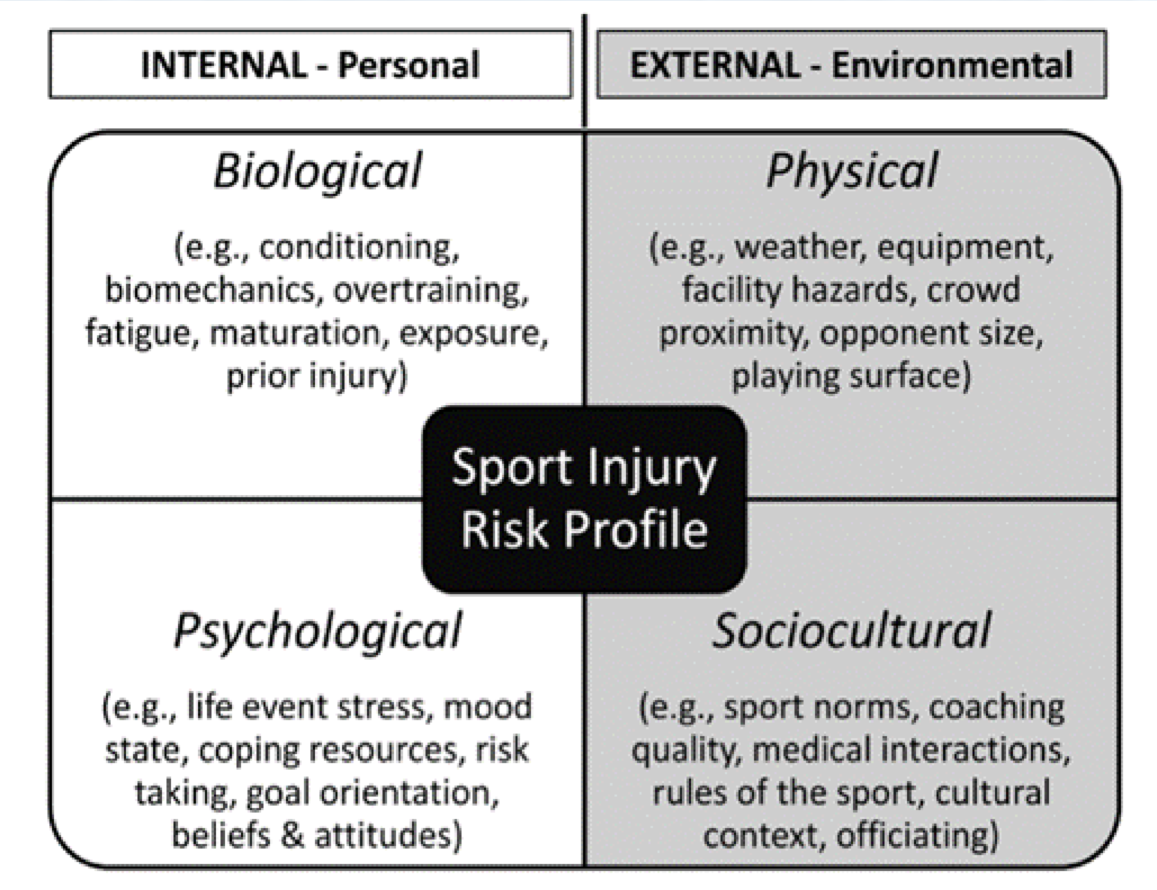
B

These approaches are in line with traditional biomedical models which typically focuses on the physical aspects of sports injury.

Mechanisms of sport injury may go beyond the physiological and biomechanical changes of the joint and may involve a systematic neurological response to injury.

The morphology, brain function and neuroprocessing change over time from the occurrence of musculoskeletal injuries and the maintenance of chronic pain symptoms.

Psychological factors are an inherent risk factor that exposes the athlete to injury and should be considered in word injury prevention programs.

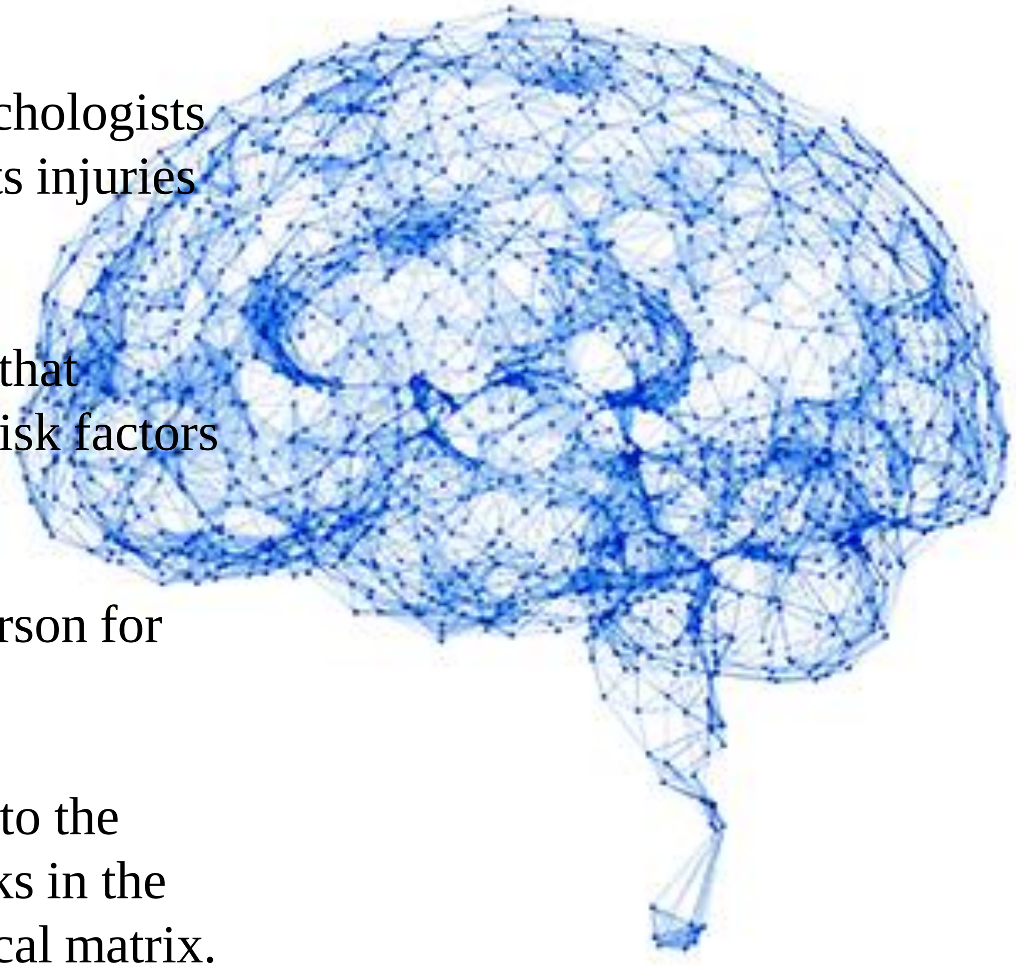


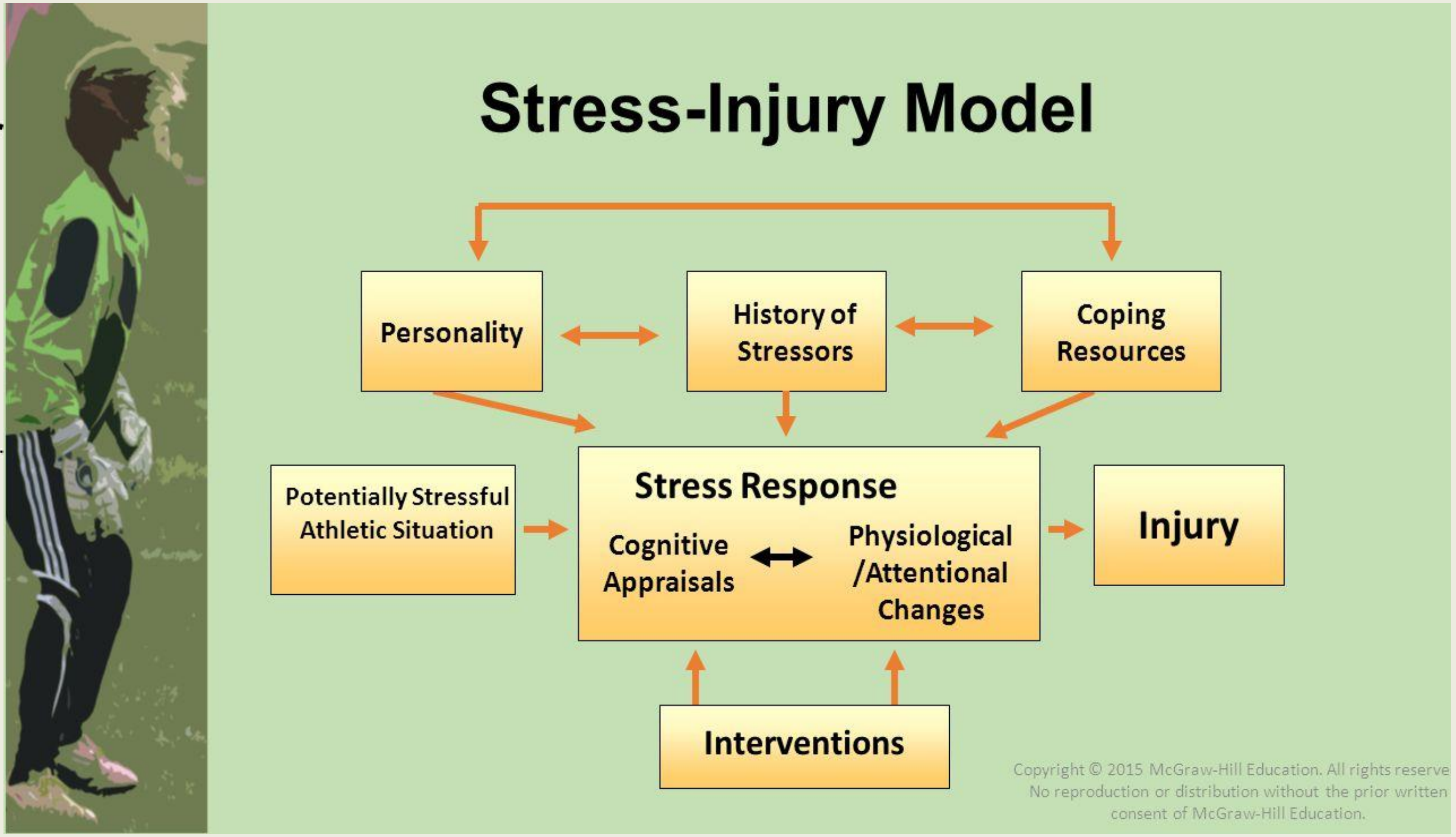
Over the past decade, sports medicine specialists and sports psychologists have tried to address the role of psychosocial factors in the sports injuries process.

The model psychological and of stress and sports injuries states that behavioral and physiological should be considered as potential risk factors for sports injuries.

In this regard, the interventions proposed by Williams and Anderson for prevention focus on neurocognitive processes (eg, attention).

Neurocognitive functions are cognitive functions closely linked to the function of particular areas, neural pathways, or cortical networks in the brain, ultimately served by the substrate of the brain's neurological matrix.





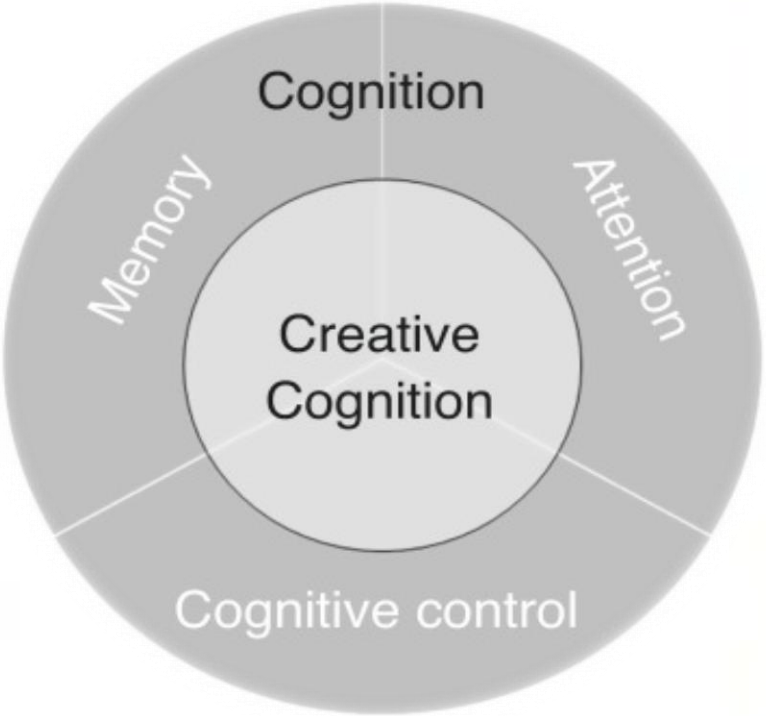
The stress-injury-model (Williams & Andersen)

Neurocognitive functions are known as indirect assessments of brain function. previous literature suggests that these neurocognitive features may play an important role in coordination, athletic performance and injury.

Neurocognitive processes such as attention, in turn, have been proposed to influence movement control, visual-motor function, and sensitivity to injury.

Neurocognitive dysfunction affects the sensory-motor integration required for neuromuscular control and thus predisposes to non-contact injury.

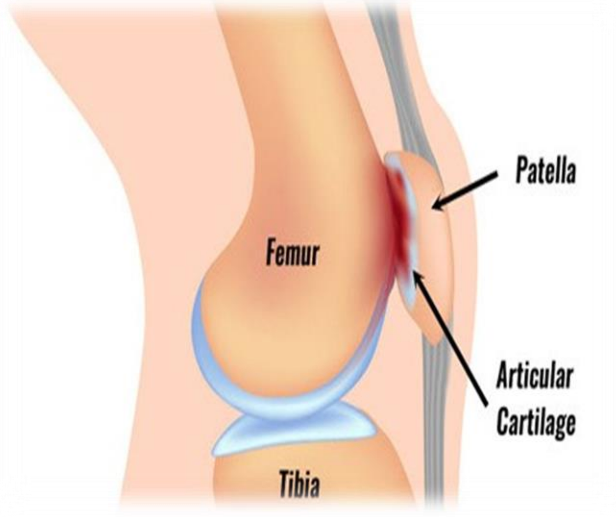
A central role in this model is played by psychological factors; in fact they have a reciprocal relationship with biological and socio-contextual factors, and with intermediate and final outcomes.

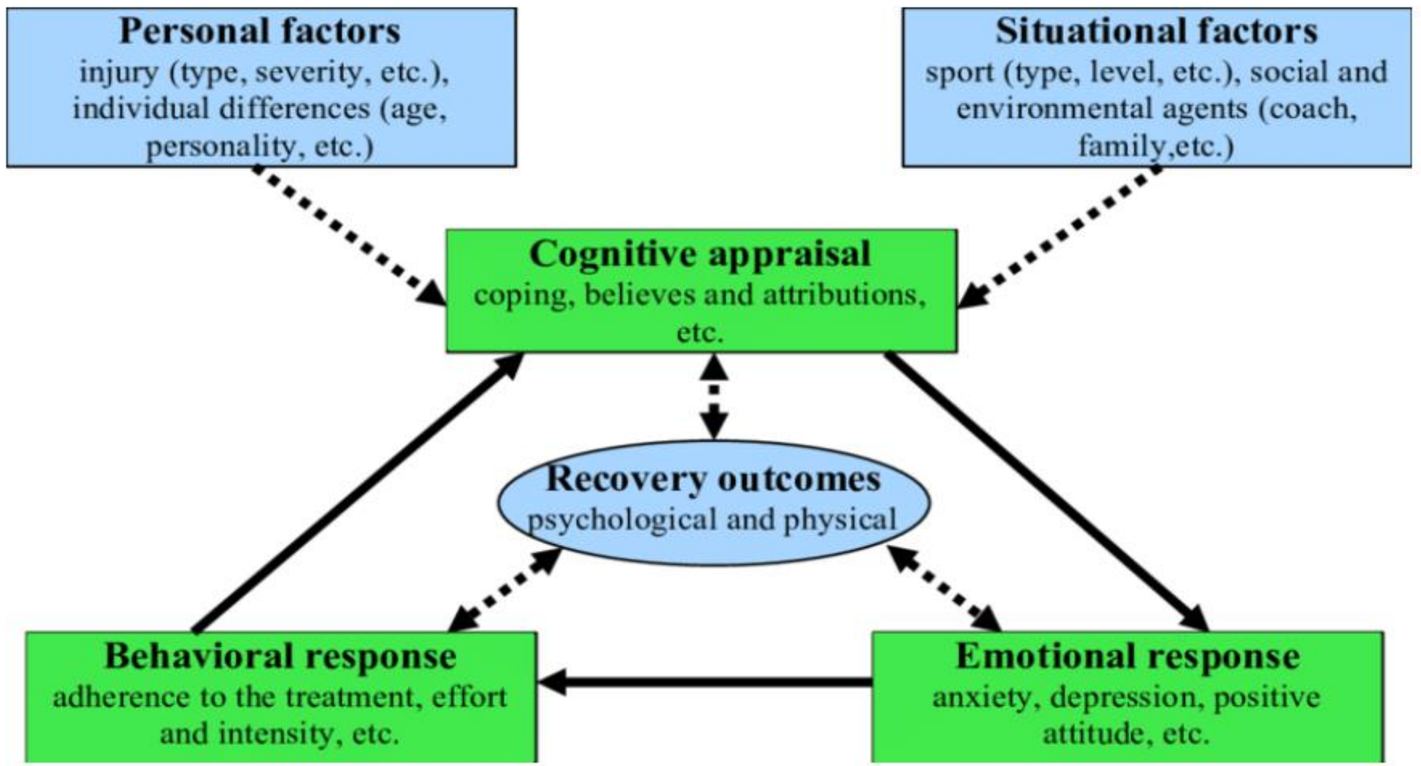


In PFPS patients, reduced knee flexion is a compensatory mechanism to avoid pain that over time becomes a pre-programmed movement pattern in the CNS and leads to osteoarthritis of the knee by increasing the loading rate of the lower limb.

As biomechanical deficits remain years after completion of rehabilitation and return to activity, understanding how the brain is generating joint motion may help us to understand why motor deficits persist.

Therefore, it is necessary to identify the neurological mechanisms that trigger pain that cause disability, motor dysfunction, and CNS dysfunction.



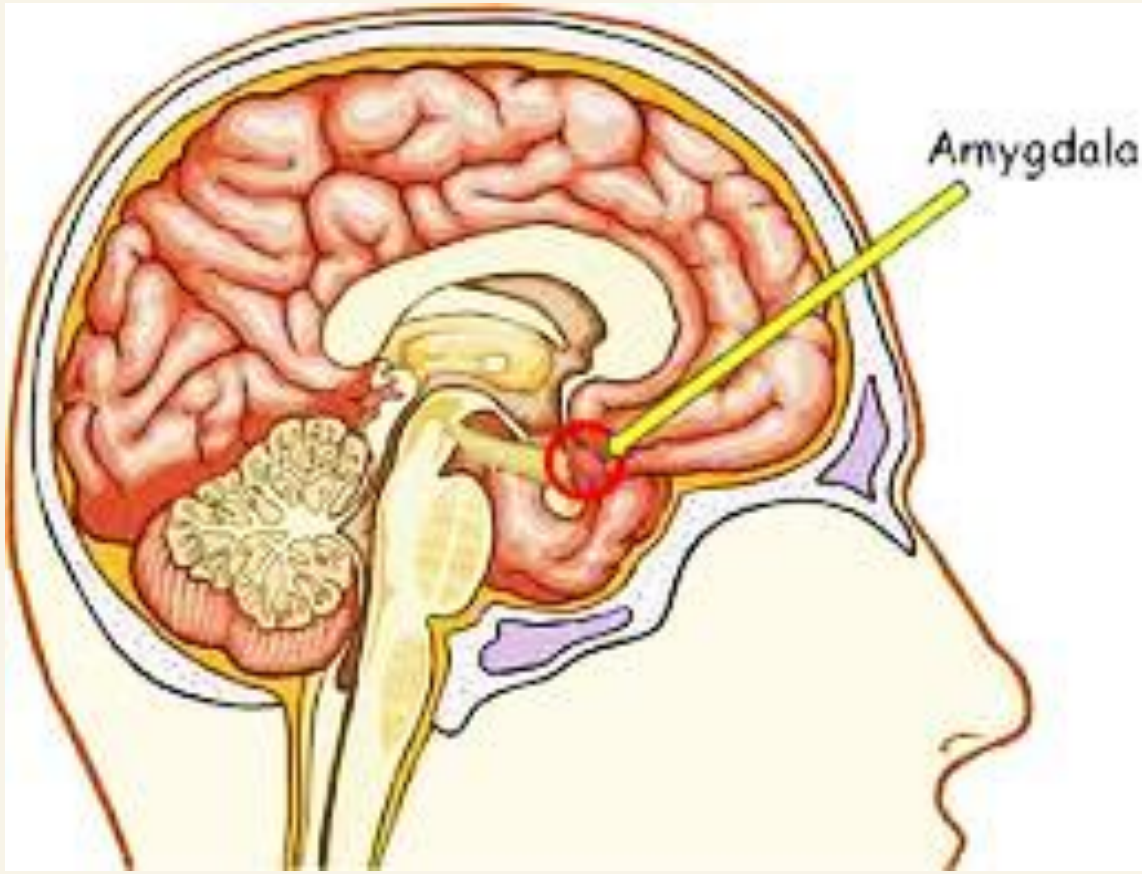


Personal factors
injury (type, severity, etc.), individual differences (age, personality, etc.)
Situational factors
sport (type, level, etc.), social and environmental agents (coach, family,etc.)
Cognitive appraisal
coping, believes and attributions, etc.
Recovery outcomes
psychological and physical
Behavioral response
adherence to the treatment, effort and intensity, etc.
Emotional response
anxiety, depression, positive attitude, etc.

In the model of stress and athletic injury, given that stress and stress responses have been found to be two of the strongest predictors of sport injuries, much attention in recent prediction research has been directed towards those variables.

Reduced stress levels are also associated with reduced amygdala activation. This may reduce injury risk as it is associated with improved attention and decision-making capacity.

This is important as decreased attention and decision-making ability is linked with increased injury risk.



- Neurofeedback is a kind of biofeedback in which people receive feedback of input signals that are related to their subconscious neural activities.
- Electroencephalography (EEG) is recorded during the neurofeedback treatment. The raw electrical signal represents the collective activity of millions of neurons in the cortex, just below the electrode.
- In NFB, one or more electrodes are placed on the scalp to measure brain wave activity at different frequency bands by electroencephalography (EEG) and provide instantaneous information.
- A patient who observes their brain waves on a computer screen can control these waves and change them based on requirements.
- Upon receiving feedback, the patient gradually learns to correct her brain activity by trial and error (voluntary control) for maximum reward.

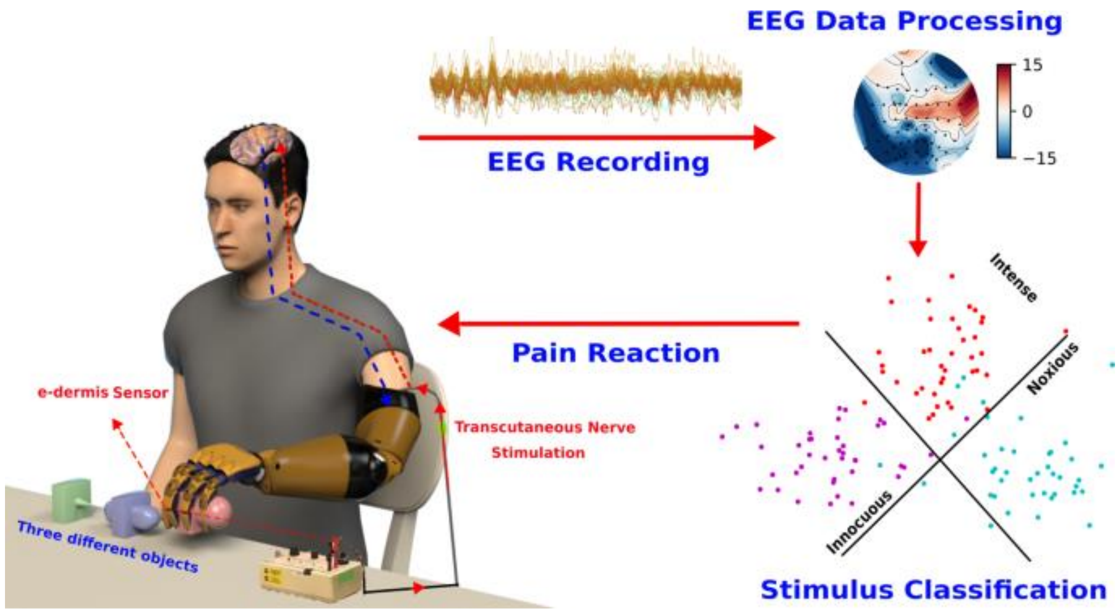
Frequency Components

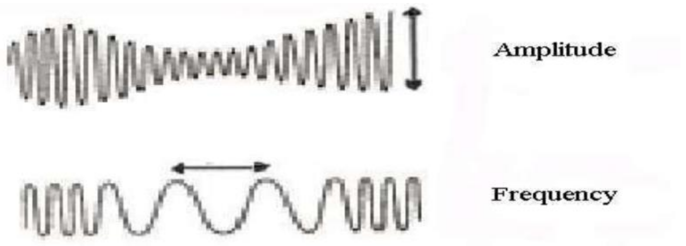
When neurons are activated, they produce electrical pulses.

By placing electrodes on the scalp, the electrical activity of the brain, known as EEG, can be recorded

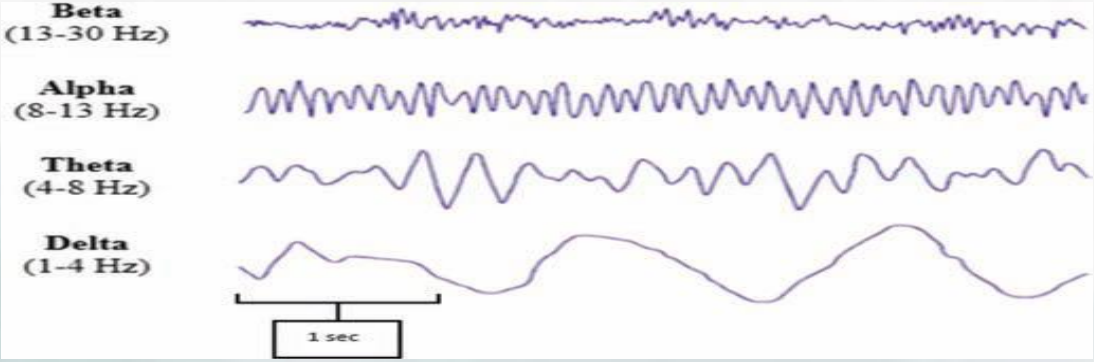
In turn, EEG is generated by a specific type of synchronous activity of neurons which are known as pyramidal neurons and the electrical output is thus reflected in the following areas of the skin where the electrodes are located.

Different patterns of electrical activity, known as brain waves, could be recognized by their amplitudes and frequencies.





Common brainwave frequency	Frequency range (Hz)	General characteristics
Delta	1-4	Sleep, repair, complex problem solving, unawareness, deep-unconsciousness
Theta	4-8	Creativity, insight, deep states, unconsciousness, optimal meditative state, depression, anxiety, distractibility
Alpha	8-13	Alertness and peacefulness, readiness, meditation, deeply-relaxed
Lower alpha	8-10	Recalling
Upper alpha	10-13	Optimize cognitive performance
SMR (sensorimotor rhythm)	13-15	Mental alertness, physical relaxation
Beta	15-20	Thinking, focusing, sustained attention, tension, alertness, excitement
High beta	20-32	Intensity, hyperalertness, anxiety
Gamma	32-100 or 40	Learning, cognitive processing, problem solving tasks, mental sharpness, brain activity, organize the brain



EEG Electrode Placement

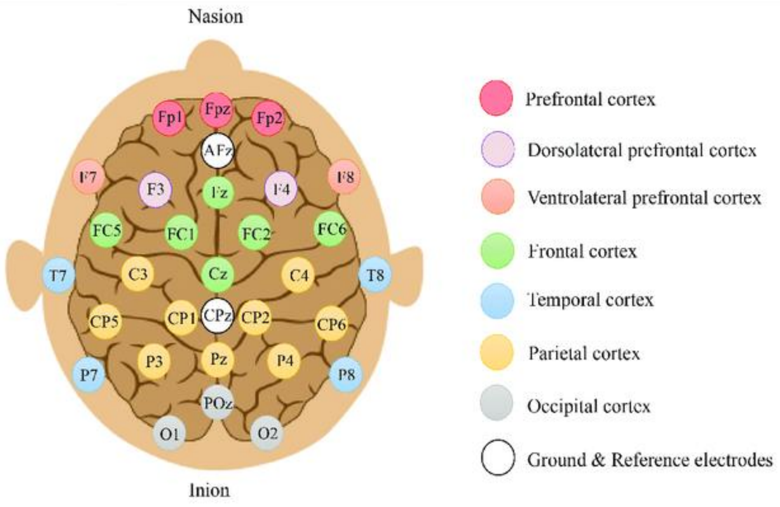
Electrodes (placed on the scalp) can record those cortical activities of the brain regions that are close to them.
Electrode System 10-20 is a method for standardizing areas of the skull and comparing data.

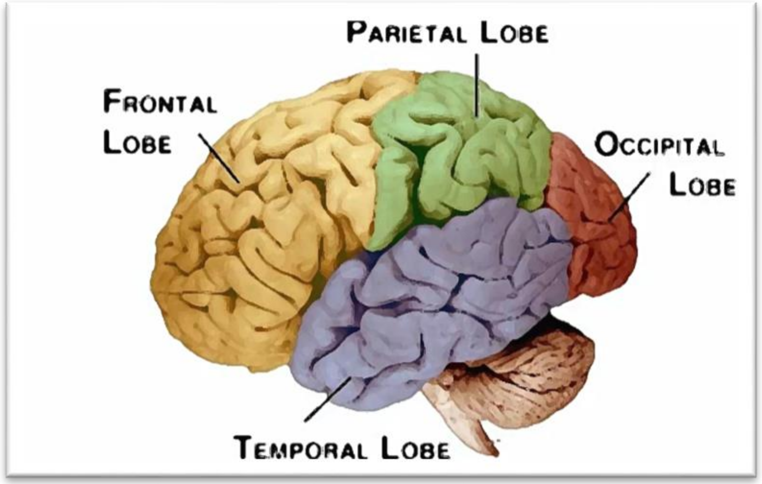
The skull regions are named using letters and numbers. Letters correspond with the brain regions and numbers to the hemisphere of the brain or the locations of this hemisphere.
The letters F, P, T, O and C are related to frontal, parietal, temporal, occipital, and central areas, respectively.

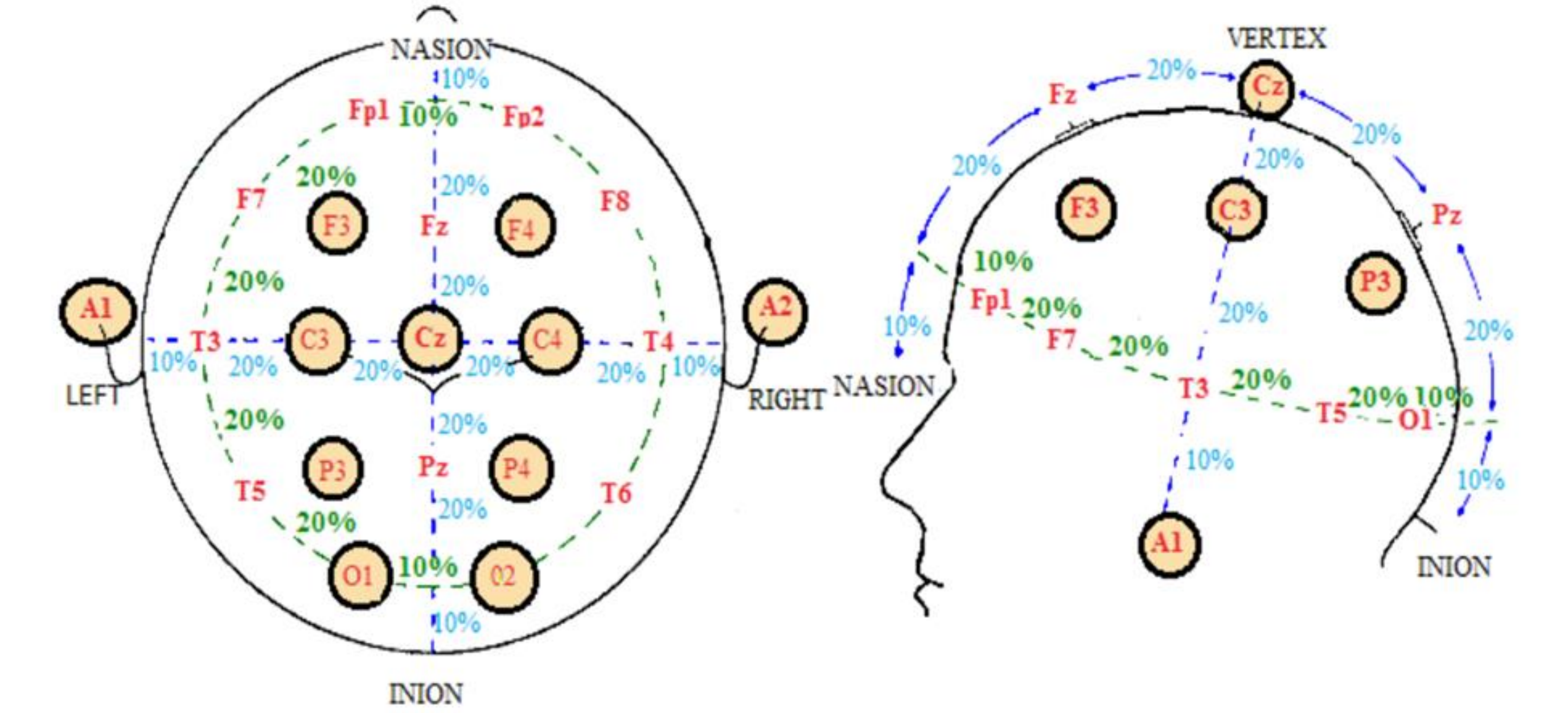
Odd/even numbers are associated with the left/right side of the brain region.
The letter z is used as PZ suggests that scalp location falls along the central line running between the nasion and the inion.

FP1 and FP2 are respectively related to the left and right poles of the forehead.

Also A1 and A2 are the left right regions of vestibular (ear) region that are two common sites for the placement of reference and ground electrodes.







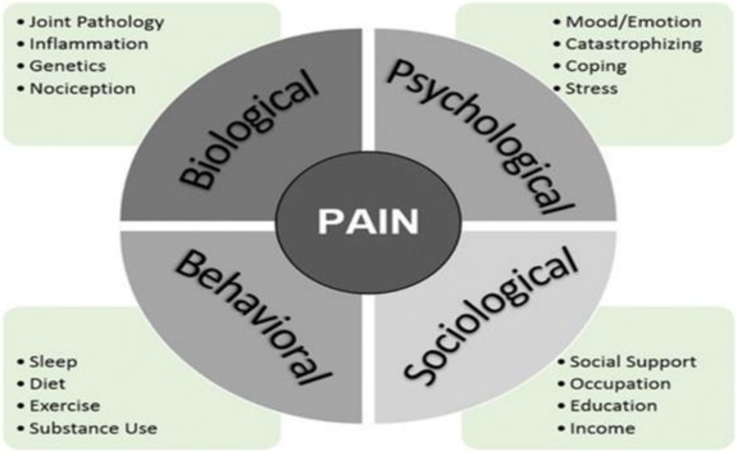
International 10-20 System

Pain is the predispose to mental disorders such as fear or avoidance of activity in order to reduce pain during daily activities.

The use of psychological-neurological interventions and its effect on the results of orthopedic research in the field of chronic pain patients is very rare.

SMC activity and altered motor cortex play a major role in pain experience.

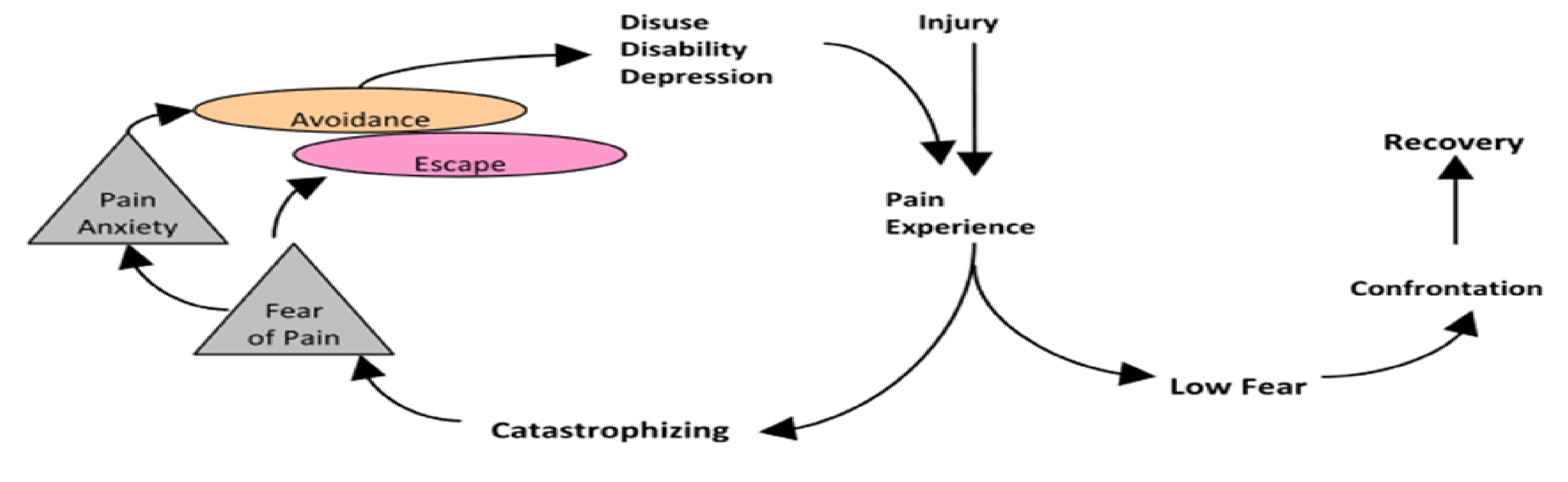
Chronic pain changes the function of the cerebral cortex from the pain circuit to emotions, so pain relief may first appear in emotionally related cortical structures.



The fear-avoidance model (or FA model) is a psychiatric model that describes how individuals develop and maintain chronic musculoskeletal pain as a result of attentional processes and avoidant behavior based on pain-related fear.

The fear-avoidance model is developed by the fear of movement; Thus, various psychological and behavioral aspects such as catastrophic pain and avoidance of movement may eventually lead to physical destruction of the musculoskeletal system.

Behavioral changes due to injury, pain, instability, compensatory movement patterns can cause unique neuroplastic changes associated with movement disorders.

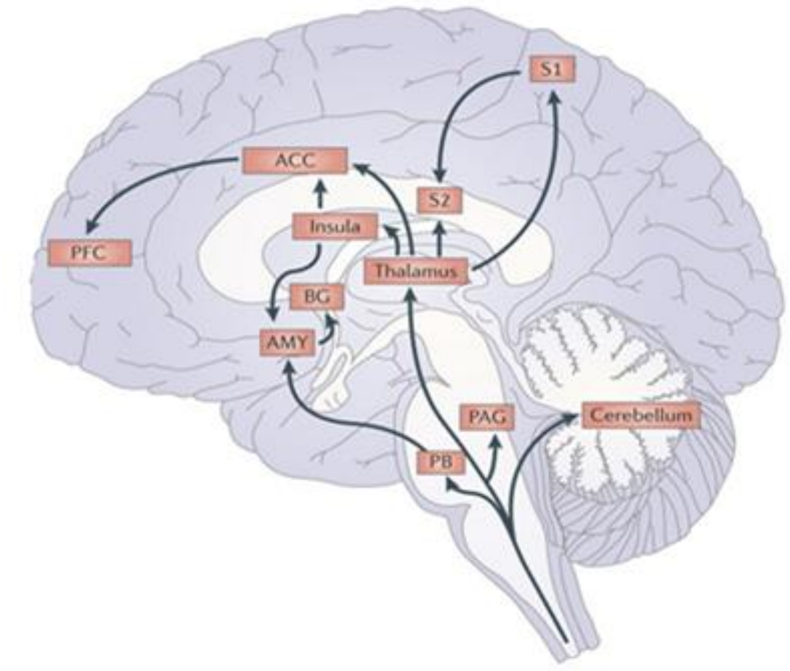


The fear-avoidance model

Brain connectivity refers to a pattern of anatomical links ("anatomical connectivity"), of statistical dependencies ("functional connectivity") or of causal interactions ("effective connectivity") between distinct units within a nervous system.

Pain is associated with the activation of an extensive network of areas of the brain, including the sensory motor area, insular, cingulitis, forehead cortex, thalamus, lower cortex, and brainstem.

Studies suggested that brain changes its functional organization at the level of the somatosensory cortex in chronic pain patients



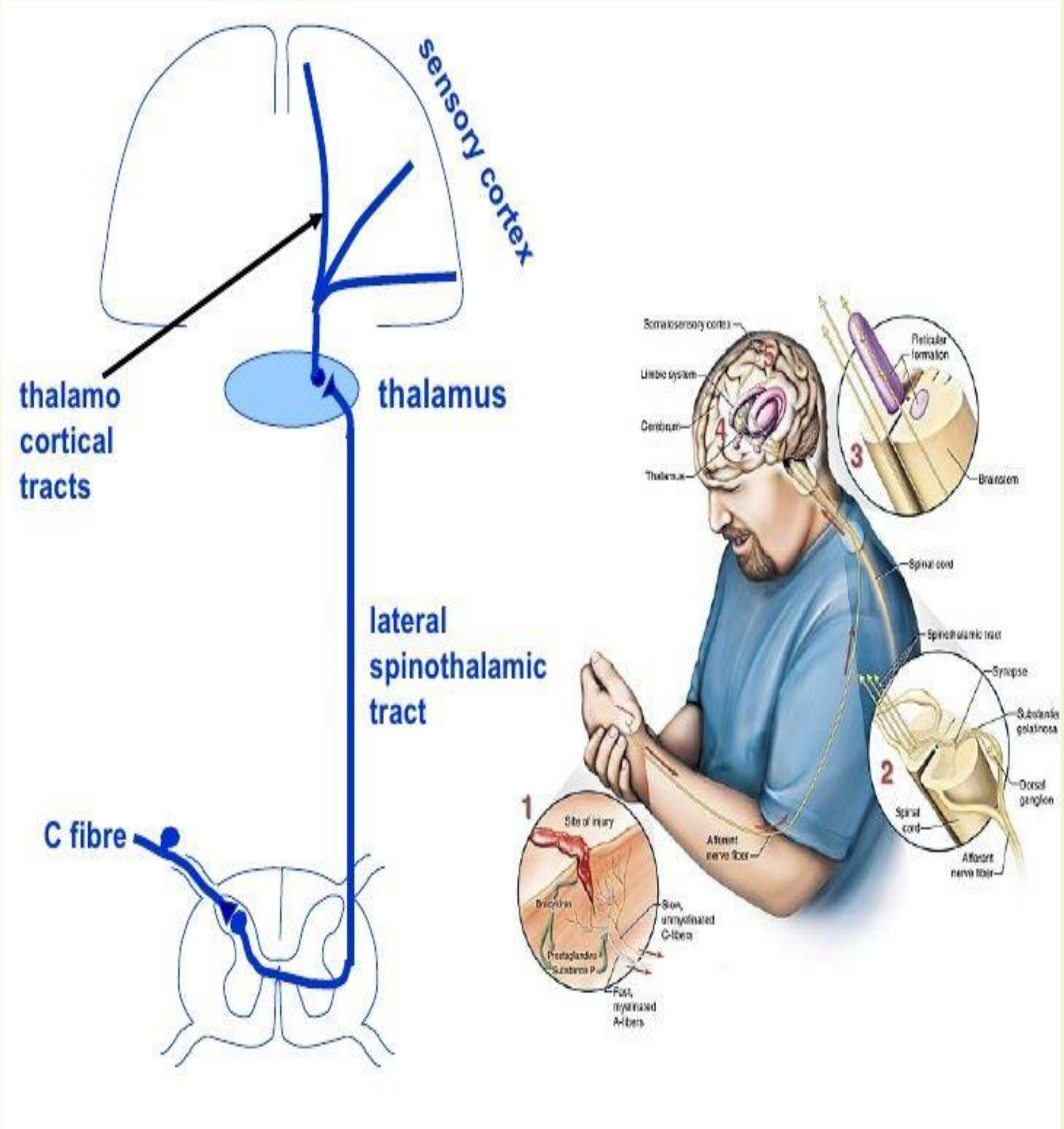
pain mechanism model

The thalamus is the gateway to the cerebral cortex, and all sensory-motor afferents are amplified through the thalamus.

Increased thalamic activity is associated with increased pain perception, resulting in increased perception of painful afferents and persistence of symptoms over time.

Increased SMR in SMC is associated with suppression of afferent, and its increase can lead to thalamic inhibition and reduce impulse and hyperactivity.

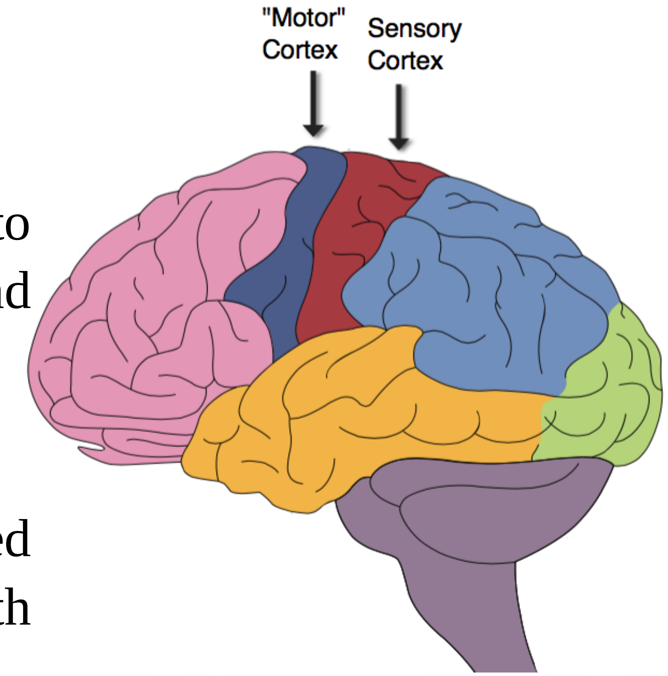
NFBT facilitates thalamic inhibitory mechanisms and can reconstruct pain pathways in patients with chronic pain and have a positive effect on pain central regulation.



SMC is attached to the amygdala, which plays a key role in recognizing and processing emotions.

In general, the pain stimulus alters the transmission of the neural message to the amygdala, which is an important area in the processing of pain and emotional states affected by it, such as fear and anxiety.

In this regard, Meier et al. Reported a correlation between increased amygdala activity and increased scores of fear of movement in patients with chronic low back pain.



It should be noted that NFBT did not treat the underlying cause of the pain; Therefore, the mechanism of action of NFBT in reducing pain may be:

1) NFBT affects brain waves at specific bandwidths that reflect the neurophysiological processes of pain experience and changes them to a state of relaxation.

1) NFBT alter brain function by altering the recording and interpretation of pain information. In other words, the intensity of perceptual pain decreases regardless of the number and amount of pain signals sent to the brain.

To fully understand the psychological response, its effects on cognitive, emotional, behavioral, and physiological systems must be considered.

The an intervention should focus on (a) changing the cognitive assessment of stressful events and (b) modifying the physiological and attention-grabbing aspects of the stress response.

An increase in the β-band makes the neural network less responsive to input signals, thus reducing the data encoding capacity.

In general, an increase in β is anti-motile in nature and is associated with a reduction or inhibition of the reaction.

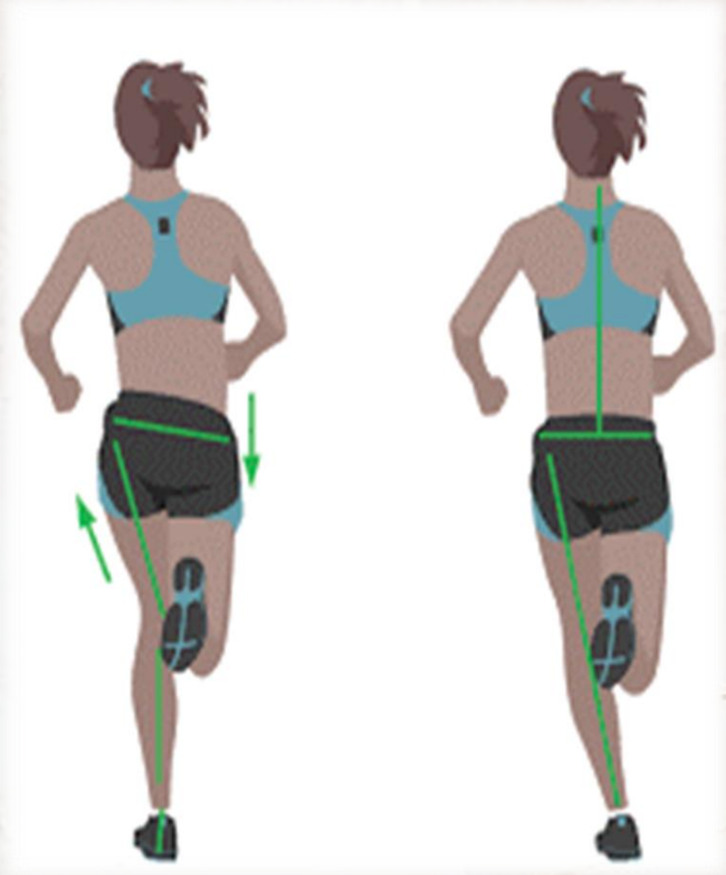
In general, an increase in β is anti-movement in nature and is associated with a reduction or inhibition of the reaction.

Therefore, increasing β indicates that the cortical function is not normal and can lead to a decrease in the speed of execution of motion.

With the occurrence of biomechanical and neurosensory disturbances, the sensory cortex of abnormal brain recipients receives from the receptors, which reduces the accuracy of the three-dimensional position of the joint or more accurate motor information to the motor cortex.

SMF wave amplification in NFBT of Improves motor development from the occurrence of neuroplasty.

Recognition is an important component of motor control and contributes to the success of motor behavior before the start and after the end of the movement.



"thank you for your ATTENTION :)"