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Review

Facing the experience of pain: A neuropsychological perspective

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Abstract

Pain is an experience that none of us would like to have but that each one of us is destined to experience in our lives. Despite its pervasiveness, the experience of pain remains problematic and complex in its depth. Pain is a multidimensional experience that involves nociception as well as emotional and cognitive aspects that can modulate its perception. Following a brief discussion of the neurobiological mechanisms underlying pain, the purpose of this review is to discuss the main psychological, neuropsychological, cultural, and existential aspects which are the basis of diverse forms of pain, like the pain of separation from caregivers or from ourselves (e.g., connected to the thought of our death), the suffering that we experience observing other people's pain, the pain of change and the existential pain connected to the temporal dimension of the mind. Finally, after a discussion of how the mind is able to not only create but also alleviate the pain, through mechanisms such as the expectation of the treatment and the hope of healing, we conclude by discussing neuropsychological research data and the attitude promoted by mindfulness meditation in relation to the pain. An attitude in which, instead to avoid and reject the pain, one learns to face mindfully the experience of pain.

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Keywords: Pain; Neuropsychology; Mindfulness; Self; Time; Mind**1. Introduction**

Every human being is destined to meet pain in his life. Aeschylus (525–456 BC), the great Greek playwright, majestically expressed this concept: "No mortal ever spend their lives completely unscathed from pain, everyone pays the price of pain to life" (Aeschylus, *Coefore*, lines 1018–19). Pain is a strong, burning experience. When pain is present the whole mind is involved, when it is absent the thought recalls the threat. The experience of pain, although strong and compelling, remains in its depth problematic and complex.

The ancient Greeks called the pain "*algos*" and referred to physical pain on one side (I feel pain, I am sick, I suffer, etc.), while at the same time recognizing to pain an inner component, which we call psychic (I am distressed, afflicted, troubled, etc.) [1,2]. Humans, like many other living beings, do not feel pain only in the presence of an injury or

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during an illness but also due to a separation from, for instance, the caregiver. When one removes the mother hen, chicks begin to chirp for the pain of separation from the mother, the same way as the kittens or small human beings [3–6].

Along with the pain of separation humans can feel the pain of others. When a child is sick and suffering, the mother generally identifies herself in the pain of her baby and she suffers as well. Psychology calls “empathy” the capacity to suffer next to another. In everyday life, the ability to share the sorrows of others is called compassion [7,8]. Humans can experience pain in many forms: physical pain, the grief of separation, and the pain of others; however, the most terrible form with which we must confront all our life is probably the anxiety and anguish of pain that can happen to us in the future [9].

Probably humans are the only living beings capable of imagining the future. They live with a neuropsychological device that is able to reconstruct the past (episodic memory) and to imagine the future. This device allows humans to travel mentally in time [10,11]. The possibility of living and travelling mentally in time is the basis of many cognitive abilities typical of human beings, such as the construction of instruments and the ability to develop stories. However, the sense of time has placed humans in front of their most certain possibility, namely that of being sure to die. For this reason the ancient Greeks called human beings “the mortals” [2,12]. Hence, human beings have thought of their own death [13].

The anguish of the death of our loved ones and the thought of our death are probably the basis of the fundamental questions of existence: why I came to the world, what I am called to do in this life, what will happen to me after death? Generally, those who think of their death do not smile. Many prefer to avoid the concern of death not thinking about it, while others are caught by fear or dread. In the more balanced conditions, the thought of our own death is associated with melancholy, a pain experience difficult to define: mild, deep and poignant. In this regard it should be noted that the Greek word “*algos*” is also connected to the word “*alego*” which means: “I care”, “I am prompt”, from which the Latin word “*religio*” derives [9,14,15]. The experience of pain is therefore not only the basis of neuropsychological and philosophical reflection but also a royal road that leads to the existential dimension.

2. The neuroscience of pain

The human body has numerous receptors for pain arranged on the surface of the body (skin), into the deeper tissues (muscles, tendons, bones) and in the internal organs. These receptors signal to the central nervous system the presence of a lesion, a fracture or of an inflammatory reaction. The information of pain receptors (nociceptors) reach the spinal cord (or the nuclei of the cranial nerves for pain sensations of the head) using fibers coated or not with myelin ($A\delta$ myelinated fibers and unmyelinated C-fibers). In the spinal cord these fibers are connected with the neurons of the first lamina of the posterior gray horns. This is a neural structure that has evolved from the sympathetic nervous system, a system involved in the alert reactions (e.g., preparation for fight or flight) and stress [16,17]. This allows us to understand why a painful stimulus generally causes a reaction of alert, waking up, or anxiety.

The neurons in lamina I of the posterior horns give rise to a bundle of fibers that pass into the anterolateral white column in the spinal cord: the spinothalamic bundle. There are several pathways and systems that process painful information in the brain [18]. For reasons of simplicity we mention the three major components of what has been called the “pain matrix”: the lateral system, the medial system, and the descending system implicated in the control of pain [19] (Fig. 1). The lateral system involves the lateral spinothalamic ascending pathways that project to the lateral thalamic nuclei and hence to the primary somatosensory areas of the parietal cortex. This system is able to discriminate the intensity, duration, and location of the painful stimulus. The medial system also originates from the spinothalamic bundle but involves the medial thalamic nuclei. These nuclei project their information to the structures of the limbic system, namely to the anterior cingulate cortex (ACC), the orbitofrontal cortex (OFC), (anterior) insula, and the parietal operculum. The medial system is thus responsible for the emotional processing of pain, namely the feelings of suffering and distress [20,21].

As we mentioned, in humans there also exists a descending system responsible for the regulation of pain (Fig. 1B). Many brain structures, if stimulated electrically during neurosurgery, are able to inhibit pain. Of these structures, the most important are the ACC, OFC, the primary and secondary somatosensory cortex and some subcortical structures, such as the hypothalamus, thalamus, and amygdala [22]. However, the structure that can produce the most important analgesic effects is located in the brain stem and is the periaqueductal gray (PAG). From the PAG other fibers originate

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