RICERCHE

Pain and Consciousness in Humans. Or Why Pain Subserves Identity and Self-representation

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Abstract Traditional definitions of pain assume that an individual learns about pain through verbal usages related to the experience of injury in early life. This emphasis on the verbal correlates of pain restricts our understanding of pain to the context of adult human consciousness. In this paper we instead support the idea that our understanding of pain originates in neonatal experience and is not merely a verbally determined phenomenon. We also challenge the definition of pain as a merely sensory message related to peripheral tissue trauma. We aim to move beyond this definition by considering the relationship between the centre (Central Nervous System) and periphery, taking into account certain phenomena such as phantom limbs and interoception. We show that pain helps an individual to develop a sense of awareness of himself immersed in a social context, and is thus a complex and adaptive phenomenon, that supports bodily integrity and social behavior.

KEYWORDS: Awareness; Consciousness; Experience; Pain; Self-representation

Riassunto *Dolore e coscienza negli esseri umani. Ovvero, perché il dolore favorisce l'identità e la rappresentazione di sé* – La definizione classica di dolore presuppone che l'individuo ne apprenda l'uso verbale attraverso esperienze dolorifiche legate all'infanzia, favorendo una maggiore attenzione per i correlati verbali del dolore. Questo spesso relega il dolore nel contesto della coscienza dell'uomo adulto. Il presente lavoro si propone, in primo luogo, di sottolineare alcune evidenze, a partire dall'esperienza neonatale, a sostegno dell'idea di dolore come esperienza umana e non solo come fenomeno determinato verbalmente. Un secondo aspetto emerge dalla definizione di dolore, il concepirlo come un semplice messaggio sensoriale in seguito a lesioni dei tessuti periferici. Ci si propone, pertanto, di andare oltre tale ipotesi considerando il rapporto tra centro (Sistema Nervoso Centrale) e periferia, a partire da alcuni fenomeni come l'arto fantasma e l'interocezione. Il dolore aiuta inoltre a sviluppare un senso di consapevolezza di sé immerso nel contesto sociale; si tratta dunque di un fenomeno complesso e adattivo, dall'integrità fisica alla dimensione sociale.

PAROLE CHIAVE: Consapevolezza; Coscienza; Esperienza; Dolore; Rappresentazione di sé

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A definition of pain: Implications for consciousness and "experience"

THE INTERNATIONAL ASSOCIATION FOR THE Study of Pain (IASP) Committee on Taxonomy (Merskey, 1997) defined pain as «an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage», and further pointed out that «pain is always subjective. Each individual learns the application of the word through experiences related to injury in early life».[1] It would appear that in our community the concept of pain is based on the definition rather than the experience of pain.[2]

This definition, in fact, emphasizes verbally expressed pain.[3] Thus, it applies only to pain that is experienced within the context of adult human consciousness, and imposes on all other definitions of pain the impossible task of demonstrating an experience without access to the means by which that experience can be demonstrated.[4] Among others, this excludes the experience of infants: newborn infants are not considered to be conscious beings but mere complex automatons made up of different reflexes.[5] It was proposed that infants were incapable of experiencing pain as defined by the IASP because they lack consciousness, and that consciousness or self-awareness develops as a result of accumulated experiences during infancy. Anand and colleagues have, instead, proposed that pain perception is an inherent characteristic of life, which occurs in all viable organisms that have a nervous system.

Various findings support the idea of pain as a human experience and not only a verbally determined phenomenon: firstly, the fact that at birth the human neonate is clearly aware of the events, people, and other objects within its environment.[6] When awake, infants continuously use their gaze to explore and then fixate objects in their environment. These fixations elicit parental responses. Infant states of consciousness are well developed and have been described as behavioral states by Brazelton, Prechtl, Amiel-Tison and others. Dynamic interactive processes between the neonate and his/her caregiver and environment occur from the earliest stages. Further, evidence from studies of postnatal behavior in preterm infants, which shows multiple parallels with the behavior and ability of full term infants as described above, supports the hypothesis that identity and consciousness have already developed at the moment of birth.[7] If premature neonates at the very beginning of their life can respond to and organize their experiences, there is a real possibility that rudimentary forms of these abilities are already present in utero. This raises the question of fetal consciousness. It is known that thalamocortical connections have already been established in utero.

If cortical activity can be considered a marker for fetal consciousness, we know that electroencephalograms (EEGs) show such activity from 19 to 20 weeks of gestation. Sustained EEGs can be recorded from fetuses at 23 weeks' gestation, the two cerebral hemispheres become synchronous from 26 to 27 weeks, and somatosensory stimuli can elicit prolonged evoked potentials from sensory cortex in 25-week preterm neonates.[8] EEG recordings and ultrasound studies allow us to differentiate between the sleep states and wakefulness of fetuses in the third trimester of pregnancy.[9] From about 20 weeks, fetuses start responding to touch[10] and sound[11] with progressive increases in the complexity of their spontaneous movements thereafter.[12]

Another issue related to the definition of pain results from the fact that a sensory neurophysiology framework has dominated pain research from its inception and shaped the understanding of both philosophers and the lay public. We argue that the relationship between the centre (Central Nervous System) and periphery is an important focus to develop, for a better comprehension of what are and what are not conscious aspects of pain.

The strictest neurophysiological concept of pain holds that it is a sensory message related to peripheral tissue trauma: specifically

and accurately coded in peripheral nerves, transmitted by the central neural pathways, and decoded in the brain. How the signals which complete the path from periphery to cortex are interpreted is never formally specified, but an implicit Cartesian dualism pervades the literature. That is, the brain detects and perceives pathological bodily processes in a passive and mechanical way. This perspective has deep historical roots. Starting from the view that the body and mind are separate entities, early philosophers and scientists asserted that pain is a specific modality, a direct sensory projection system that brings injury signals from damaged tissue to the brain, where the mind evaluates them. This perspective went unchallenged for two centuries, and it still exerts considerable influence today. The neurophysiology model tacitly assumes that a conscious entity somehow receives and interprets tissue trauma alarm signals.[13]

Scientists alike assumed, until the 1960s, that tissue trauma activates specific receptors and that signals of tissue trauma follow specific pain pathways through the spinal cord to a pain center in the brain.[14] In this classical framework, pain is the sensory end product of an essentially passive information transmission process. Today, pain researchers recognize that pain has both sensory and emotional features and can command attention as well as dominate other cognitive processes; so pain has come to be understood as an extraordinarily complex process.

Nevertheless, the periphery, in a strictly sensorial sense, is apparently not entirely necessary in this process, as illustrated by a particular pain phenomenon: the Phantom Limb. In this regard, the work of Melzack is enlightening, since he pointed out that because the phantom limb feels so real, it is reasonable to conclude that the phantom experience is subserved by the same neural processes in the brain as normal bodily experience; the relevant brain processes are normally activated and modulated by inputs from the body but they can also act in the ab-

sence of any inputs.[15] Qualities we normally feel in the body, including pain, are also felt in the absence of inputs from the body. This suggests that the origins of the patterns that underlie the qualities of experience may lie in neural networks in the brain; stimuli may trigger these patterns but do not produce them.

The body is perceived as a unity and is identified as the "self," distinct from other people and the surrounding world. The experience of a unity of such diverse feelings, including the self as the center point of orientation in the surrounding environment, is produced by central neural processes and cannot derive from the peripheral nervous system or spinal cord.

On the other hand, a theory which stresses the fundamental importance of central neural processes raises the question of how pain is related to consciousness and how, in pain experience, cognition and emotion appear to be inseparable. If this is so, then evolutionarily newer structures, namely, the later stages of cortical development, should have demonstrable links with limbic structures and functions and such interconnections clearly exist. Parts of the frontal lobe originated in the rudimentary hippocampal formation, while other parts (the paleocortical trend) originated in the olfactory cortex. While these two areas are anatomically interconnected, the former analyzes sensory information while the latter contributes emotional tone to awareness of that sensory information.[16]

Pribram,[17] noting that limbic function involves the frontal and temporal cortices, offered a bottom-up concept for the relation between cognition and feelings: that is, emotion determines cognition. However, the multimodal neocortical association areas project corticofugally to limbic structures,[18] suggesting that cognition can also drive emotion. Because cognition and emotion appear to be in a reciprocal relationship, we underscore the interdependency of emotion and cognition, as they modulate and modify the pain experience.

Also, differences in the expression of pain among people suggests that pain is not merely an information process: while medical imaging demonstrates that many people with tissue pathology report no pain, it also reveals that people disabled by chronic pain sometimes have little or no identifiable tissue damage. More importantly, patients seeking relief from pain rarely complain of unwanted sensory information; rather, they suffer from the emotional distress of the pain. Thus, while sensory qualities are quantifiable and are the more evident features of pain, they are only partial indicators of pain as a conscious experience. The affective aspects of pain, while much harder to engage scientifically, are more important to the sufferer than the sensory signals. The difference does not derive from different levels of nociceptive input to the brain but rather from the complex interdependence of cognition and emotion.[19]

Chronic pain goes beyond nociception: Pain matrix and interoception

Clinical researchers often distinguish between acute and chronic pain. Acute pain is a complex, unpleasant experience with emotional and cognitive, as well as sensory, features that occurs in response to tissue trauma. Pain involves sensory awareness of tissue trauma accompanied by strong unpleasant emotions, cognitions, and myriad, normally protective, physiological arousal responses. Evolutionary biology provides a good explanatory framework for acute pain. The capacity to feel pain evolved to promote successful adaptation and to increase chances for survival. The purpose of acute, short-term pain is evident: it protects against further significant injury. Acute pain evoked by brief noxious inputs has been deeply investigated by neuroscientists, and the sensory transmission mechanisms involved are generally well understood.[20] In contrast, chronic pain syndromes, which are often characterized by severe pain associated with little or no discernable injury or pathology, remain a

mystery. Furthermore, chronic psychological or physical stress is often associated with chronic pain, but the relationship is poorly understood.

In some cases, pain persists beyond the healing time needed for recovery from an injury, extending indefinitely because of factors that are pathogenetically and physically remote from the originating cause. Often, such pain has little or no relationship to observable tissue damage. Pain that persists indefinitely under these conditions is chronic pain. We all know that pain has many valuable functions. It often reveals injury or disease and produces a wide range of actions to stop it and treat its causes. Chronic pain, however, is clearly not a warning to prevent physical injury or disease.

Chronic pain is a topic that has profoundly influenced the development of many areas of medicine. Is has been recognized as a disease[21] with a specific nosology; its chronicity originates from an organic condition no longer solvable, and the diagnosis specifically refers to a pain that persists for more than 3 months or beyond the expected time for healing.[22] Unlike acute pain, which has an informative value, chronic pain is purposeless[23] and it refers to a specific alteration that cannot be solved by the regenerative capacity of the organism. For this reason, chronic pain has additional requirements beyond classical biomedical models. Pain medications show their problematic nature, since resistance thresholds, addictions and pharmacological interactions often make it difficult to continue therapies while maintaining effectiveness.[24]

Some relevant relationships underlie pain and self-representation. Indeed, Chapman and Nakamura propose that pain, like consciousness itself, embodies cognition and emotion. Because consciousness by its very existence implicates self, so does pain. Studies of self in psychological science have a long history, and an excellent interdisciplinary resource illustrates the wealth of existing knowledge.[25] Self is a construct with hierarchical organization that has different mean-

ings at different levels of the neuraxis. Multiple levels of the self exist, and each level becomes a precondition for the existence of higher levels. At the level of consciousness, the self is what each of us considers to be "me" or experiences as "me".[26]

Nonetheless, one can define and investigate the self biologically, psychologically, or socially. Our concerns here are with the biological and psychological levels. Multiple psychological dimensions of the self also exist. At the most fundamental level there is the self-as-agent, which engages in biological adaptation and survival. From an evolutionary perspective, it is the agent for survival. The self as-agent sets goals, chooses among alternatives, and engages in behaviors. Animals and humans both exhibit a self-as-agent, and this self is, in part, social. That is, it exists not alone but in relationship to others of its kind.[27]

The self exists as a central representation of the body, instantiated at a neurological level. Melzack's Neuromatrix Theory[28] attempts to describe the nature and role of higher central mechanisms underlying the sense of bodily self. The Neuromatrix Theory proposes a central representation for body parts that exists independently of stimulation from the periphery. This formulation derives from Melzack's research on phantom limb pain. In addition, Melzack wanted to introduce adjustments to gate theory.[29] These adjustments do not negate gate theory, since peripheral and spinal processes are obviously an important part of pain.[30] But the data on painful phantoms below the level of total spinal section indicate that we need to go beyond the foramen magnum and into the brain.[31]

Starting with the fact that the phantom limb feels so real, it is reasonable to conclude that the phantom experience and the body we normally experience is subserved by the same neural processes in the brain; these brain processes are activated and modulated by inputs from the body but they can act in the absence of any inputs. All the qualities we normally feel from the body, including pain, are also felt in the absence of inputs from the body; from this we may conclude that the origins of the patterns that underlie the qualities of experience lie in neural networks in the brain; stimuli may trigger the patterns but do not produce them.

The body is perceived as a unity and is identified as the "self," distinct from other people and the surrounding world. The experience of a unity from such diverse feelings, including the self as the center point of orientation in the surrounding environment, is produced by central neural processes and cannot derive from the peripheral nervous system or spinal cord. The anatomical substrate of the body-self, proposes Melzack, is a widespread network of neurons that consists of loops between the thalamus and cortex as well as between the cortex and limbic system. This network, whose spatial distribution and synaptic links are initially determined genetically, is later sculpted by sensory inputs, as a neuromatrix.[32] The loops diverge to allow parallel processing in different components of the neuromatrix and converge repeatedly to permit interactions between the output products of processing. The repeated cyclical processing and synthesis of nerve impulses through the neuromatrix imparts a characteristic pattern: the neurosignature.[33]

Portions of the neuromatrix are specialized to process information related to major sensory events (such as injury, temperature change) and may be labeled as neuromodules which impress subsignatures on the larger neurosignature. The neurosignature, which is a continuous outflow from the body-self neuromatrix, is projected to areas in the brain, in which the stream of nerve impulses (the neurosignature modulated by ongoing inputs) is converted into a continually changing stream of awareness. The neuromatrix "casts" its distinctive signature on all inputs (nerve impulse patterns) which flow through it. The final, integrated neurosignature pattern for the body-self ultimately produces awareness and action.

The neuromatrix, distributed throughout many areas of the brain, processes infor-

mation that flows through it, and ultimately produces the pattern that is felt as a whole body. The neuromatrix produces a continuous message that represents the whole body in which details are differentiated within the whole as inputs come into it. When all sensory systems are intact, inputs modulate the continuous neuromatrix output to produce the wide variety of experiences we feel. As Melzack says,

We may feel position, warmth, and several kinds of pain and pressure all at once. It is a single unitary feeling just as an orchestra produces a single unitary sound at any moment even though the sound comprises violins, cellos, horns, and so forth.[34]

Similarly, at a particular moment in time we feel complex qualities from all of the body. In addition, our experience of the body includes visual images, affect, "knowledge" of the self as well as the meaning of body parts in terms of social norms and values.

Self, awareness and pain – interoception

Recent anatomical studies have explored the neural pathways that create the consciousness of the body in the mind and defined the concept of interoception as the sense of the physiological condition of the entire body.[35]

Cannon proposed the concept of an internal set of parameters underlying the physiological state of the body and he defined the concept of homeostasis,[36] which implies an internal construct able to sense the state of the body, instant by instant. Before Craig's work on the lamina I spinothalamocortical system, the concept of interoception relied on a broader definition of somatic awareness that also included proprioception. Traditionally, proprioception referred to distinct discriminative cutaneous sensations, such as pain and temperature, relayed to the somatosensory cortex by the thalamic ventrobasal complex, while interoception represented the sense of visceral information from specific afferent pathways that include vagal, glosso-pharyngeal, facial and spinal afferent activity, along with information from mechanoreceptors, chemoreceptors, and osmoreceptors.[37]

Recent neuroanatomical studies indicate that the right anterior insula cortex (AIC) collects a meta-representation of the interoceptive activity in humans.[38] This representation is shaped upon subsequent cinemascopic images of the status of the entire body and provides the subjective substrate for the perception of the material self as a physical and separate entity, through a process that directly leads to subjective feelings and self-awareness. There is evidence that small-diameter (Aδ and C) primary afferent fibres fundamentally innervate all tissues of the organism. These fibers converge in a specific neural region, on the most superficial layer of the spinal dorsal horn, called the lamina I[39] which projects to a relay nucleus in the posterolateral thalamus.[40] Although, the lamina I neural region has been linked to pain and temperature specific afferent labelled lines, recent evidence shows that the Aδ and C small-diameter fibres convey homeostatic inputs from all tissues.[41]

This complex physiological interoceptive cortex is incrementally activated by temperature, pain, cardiorespiratory function, hunger, thirst,[42] local metabolic information, immune and hormonal activity, and mechanical stress.[43] Moreover, lamina I spinobulbar neurons respond selectively to muscle contractions, providing additional evidence that the interoceptive system incorporates a wide range of bodily information, including from the muscle Aδ and C fibres.[44] Lamina I neurons also integrate many cutaneous C fibres that are sensitive to slow and weak mechanical activation, suggesting that interoceptive cortex incorporates sensual (limbic) touch[45] among other afferent inputs. This conceptual framework, originally proposed by Craig, supports Damasio's somatic marker hypothesis[46] and James' theory of emotions[47] and is consistent with recent imaging studies on homeostatic processing and emotional awareness.[48]

It is interesting to discuss the relationship

between interoceptive mechanisms, self-representation and self-awareness.

Firstly, awareness of interoceptive sensations is a relevant topic that allows us to distinguish between perception and detection of interoceptive information. Detection implies a response characterized only by afferent physiological information, while perception usually involves more elaborate appraisal processes that integrate all the information available to the organism, such as expectations, memories, attention, and cognitive evaluations.[49]

Then, interoception can be subdivided into at least two different constructs which are not necessarily interrelated: interoceptive accuracy (IAc) and interoceptive awareness (IAw).[50] IAc is the ability to accurately perceive changes in homeostatic meta-representations, while IAw represents the integration of the conscious perception of these bodily signals[51] into a complex network forged from emotions, experiences, and expectations.[52] In the interoceptive system, composed of the anterior insular cortex (AIC), the anterior cingulate cortex (ACC), the prefrontal cortices and the somatomotor and somatosensory cortices, the AIC represents the core of the meta-representation that integrates all the active physiological processes inside the organism. The size and activity levels of the AIC are correlated with individuals' accuracy in sensing their own heartbeat.[53] Nevertheless, interoceptive awareness (IA) can be conceptualized both as a trait-like sensitivity and as a state-like condition since it can be manipulated through processes that alter autonomic activity.[54]

Several studies have shown evidence for a neurological pain matrix associated with chronic conditions.[55] In this regard, the interoceptive matrix plays an important role in pain perception and possibly in chronic pain conditions. Specific regions[56] in the dorsal posterior insula, are selectively activated in every fMRI study that uses noxious heat applied to the hand,[57] and these same regions are active in chronic pain subjects[58] and show evoked activity in neuropathic pain subjects.[59] The cortical interoceptive matrix is also associated with the subjective perception of pain, the anticipation of pain, the subjective reduction of pain and the subjective generation of pain.[60]

Moreover, an fMRI study on placebo analgesia provided evidence that the ACC and AIC co-activate during the subjective suppression of pain[61] suggesting that the behavioral motivational agent located in the ACC can actively modulate the interoceptive pattern in the AIC through the predictive expectation of pain, according to Craig's anticipatory global emotional moment theory. Furthermore, specific evidence suggests that the interoceptive matrix also responds to sympathetic activation[62] while the anterior and posterior insula influence the subjective experience of pain.[63]

Therefore, the interoceptive matrix seems to play an important role in the processing of pain sensations and partial evidence seems to confirm that it plays the same important role in chronic pain disorders. Craig has demonstrated the role of the ACC in the interoceptive matrix, suggesting how the ACC might represent the behavioral agent that is able to alter meta-representations inside the AIC. Conjoint factors, from experiences to expectations, can deeply influence interoceptive awareness and, although self-reported measures for IAw are possible, particular attention must be dedicated to the assessment protocol to exclude possible confounding factors related to perceptual biases.[64]

Results from various studies provide a complex picture that can be fully evaluated only after considering multiple dimensions. Finally, it seems that IAc is lower in subjects with chronic pain conditions. However, deficits in the IAc are clearly identified in only 3 studies.[65] Although Craig's definition broadly expanded the concept of interoception and although spontaneous sensations seem to be related to interoceptive awareness[66] the task and the protocol of this study seem to be biased by perception factors.

Therefore, Craig defined interoception as a sense of the physiological condition of the entire body, directly related to the sensation and experience of self.[67] Although this definition expanded the narrow concept of interoceptive visceral information that dominated the old theoretical frameworks, it also added a different level of complexity to field research. With respect to the assessment of interoception, the most reliable task for assessing IAc is the heartbeat perception task[68] along with the heartbeat discrimination task.[69] The reliability of these tasks has been supported by fMRI evidence that correlates heartbeat detection with the activity and the dimensions of the AIC1,[70] one of the core neurological systems in the interoceptive matrix.[71] Even though the heartbeat task is susceptible to several factors, such as age, gender and BMI, these influences can be partially compensated through procedures for matching control groups. Also, by administering the Spontaneous Sensations Protocol (SPS) along with the Multidimensional Assessment of Interoceptive Awareness (MAIA) questionnaire. Although the SPS assessment protocol seems sensitive to interoceptive awareness factors, spontaneous sensations are related to perceptual factors, for example they are modulated by visual attention[72] and thus special consideration must be applied in the design of the study to reduce risk of bias. Special attention should also be paid to psychological and psychopathological factors in tasks which rely on perceptual processes, considering that anxiety and psychopathological conditions can strongly alter results, both in healthy and in chronic pain subjects.

A look back to pain definition

Returning to the definition of pain, pain is a useful framework for the debate on consciousness, subjectivity, and the brain because it is typically taken to be a paradigm for the exploration of consciousness. Gillett[73] offers a philosophically rich analysis both for the importance of subjectivity in thinking about consciousness, and for the focus on lived experiences that characterize the phenomenon of consciousness. Gillet refers to «the emergent reality of individual cognitive and neurobiological activity as a being-in-the-world-with-others».[74] Searle[75] has also noted that pain does not satisfy criteria for ontological objectivity, because pain is «not equally accessible to all observers» and hence «must be somebody's pain [...] And what is true of pain is true of conscious states generally».[76] Neuroscientists working on pain have frequently characterized the meaning of pain in terms of its neuroscientific meaning. In contrast, Fields[77] inverts the hierarchy by concluding that we cannot understand the neuroscience of pain if we leave out the meaning of pain in people's lives and communities.

Indeed, human experiences of pain are modulated by top-down pathways in addition to bottom-up processes. That is, a variety of neural systems and pathways profoundly affect the experience of pain itself and the common notion of pain as originating at, for example, the site of organic injury appears to be oversimplified. Thus, Fields argues that we have to unpack what pain means in people's lives and communities to understand, even at a neuroscientific level, the phenomenon of pain.

In any case, these approaches are crucial because they focus on the role of subjectivity in consciousness. The meaning of subjectivity and its relevance to thinking about consciousness are definitive matters for neuroethicists to consider, matters that are as central as matters related to pain.[78]

We can see that phenomenology is ultimately not about purely individual or private concerns.[79] Instead, it seeks to develop a broader interpretation of a particular phenomenon (or experience) from the perspectives of several individuals. Our experience of reality is based on socially shared understandings, many of which we take for granted. The experience of the person with chronic pain constitutes a specific "lifeworld" based on these "intersubjective" understandings.[80] Phenomenology may be especially helpful in exploring individuals' lived experiences of the

lifeworld because it focuses on these taken for granted socially shared aspects of experience.[81]

From this perspective, body-mediated experiences like the experience of pain become a place of consciousness but put in a social context. Merleau-Ponty offered a concept of the body that has an embodied sense of intentionality. That is, the body is the locus of consciousness and is therefore «that which causes [things] to begin to exist as things, under our hands and eyes»;[82] thus «consciousness projects itself into a physical world and has a body, as it projects itself into a cultural world and has its habits».[83] As embodied persons, we exhibit a "bodily identity"; for example, in the unique manner in which we do "bodily" things as above. This bodily behavior «not only identifies the body as "mine" but also reflects the body as a social and cultural entity».[84] Starting from these phenomenological descriptions of the nature of perception and action (or embodiment), it can be understood that illness «is not simply a biological dysfunction of a body part, but a pervasive disturbance of our being in the world [...where...] we see the habits, which anchor our everyday routines, disrupted».[85] This kind of disruption in one's daily way of being and one's ability to act effectively in the world means that illness, such as chronic pain, is an existential and relational phenomenon as well as a biological one.

To resume, phenomenology provides insight into chronic pain as a phenomenon that erodes both identity and a sense of agency.[86]

To conclude: Why pain supports our sense of being and our daily "emotional" experience

Pain has an adaptive role with respect to ourselves and others, and it is a useful tool in daily experience. For evolutionary reasons, all living organisms are equipped with a repertoire of typical pain behaviors, evoked by stimuli that threaten their integrity or survival.

Some humans can fake them and hide them, but for the most part, these behaviors are reliable/predictable and are coordinated with physiological responses that are defensive and adaptive in nature. These behaviors and physiological mechanisms have been highly conserved, despite the progressively increasing complexities of genetic and social evolution.

For evolutionary reasons, we are also equipped with the capacity to recognize the pain of others and respond with compassionate, tending behaviors. These behaviors and capacities are pre-rational in operation, that is, when we see someone in pain, we do not rationally infer that they are in pain, we instinctively react to their pain.[87]

Negative emotion is the most evident feature of pain and it is the component that helps us adopt adaptive avoidance behaviors in case of danger, but it is not without negative implications. In fact pain can cause extreme aversiveness, an ability to annihilate complex thoughts and other feelings, an ability to destroy language, and a strong resistance to objectification.[88] If pain involves powerful, negative emotion, then it is hardly surprising that pain can produce anguish, especially when it persists. Pain-as-emotion is important because it involves extensive and elaborate patterns of physiological arousal.

This CNS arousal influences the overall health and well-being of the person, and can contribute to strong, aversive subjective experience. Psychologically, the emotional aspect of pain is important because emotion serves a communicative function. While we cannot share directly in another's sensory pain experience, we can observe the emotional expressions occasioned by another's pain and we typically react empathically and affectively to those expressions. Put another way, emotional expression makes possible the second person reality of pain, which at the sensory level it is purely first person. Empathy also develops from experiences of pain and it is a helpful capacity for daily life in a social environment. So pain can be considered not only an individual dimension of life, which supports the integrity of the person, but also social and adaptive to

social contexts.[89]

In addition, the emotional dimension of pain plays a strong role in consciousness by producing and summarizing information that helps determine alternative coping behaviors. According to MacLean, emotions

> impart subjective information that is instrumental in guiding behavior required for self-preservation and preservation of the species. The subjective awareness of affect is characterized by a sense of bodily pervasiveness or by feelings localized to certain parts of the body.[90]

This insight underscores the direct contribution of emotional arousal to cognition.[91] Within the contents of consciousness, threat is the realization of a strong negative feeling state and not a coldly calculated informational appraisal. The emotional magnitude of a pain is the internal representation of the threat associated with the event that produced the pain. [92]

Finally, we can say that pain needs consciousness to be perceived and to become the complex phenomenon described above, not merely a sensorial phenonmenon, but one which also helps the individual to develop a sense of awareness of himself (starting from physical sensations) and his immersion in a social context (starting from empathy). Pain is thus a complex phenomenon and is adaptive, supporting bodily integrity and social behavior.

▌ Notes

[1] See H. MERSKEY, *Pain, Consciousness, and Behavior*, in: «Pain Research and Management», vol. II, n. 2, 1997, pp. 118-122.
[2] See K.J.S. ANAND, C. ROVNAGHI, M. MARLENE WALDEN, J. CHURCHILL, *Consciousness, Behavior, and Clinical Impact of the Definition of Pain*, in: «Pain Forum», vol. VIII, n. 2, 1999, pp. 64-73.
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[4] See K.J.S. ANAND, C. ROVNAGHI, M. MARLENE WALDEN, J. CHURCHILL, *Consciousness, Behavior, and Clinical Impact of the Definition of Pain*, cit.
[5] See S. DERBYSHIRE, *Comment on editorial by Anand and Craig*, in: «Pain», vol. LXVII, n. 1, 1996, pp. 210-211; A.R. LLOYD-THOMAS, M. FITZGERALD, *Do Fetuses Feel Pain? Reflex Responses do not Necessarily Signify Pain*, in: «British Medical Journal», vol. CCCXIII, n. 7060, 1996, pp. 797-798.
[6] See K.J.S. ANAND, C. ROVNAGHI, M. MARLENE WALDEN, J. CHURCHILL, *Consciousness, Behavior, and Clinical Impact of the Definition of Pain*, cit.
[7] See K.J. AITKEN, C. TREVARTHEN, *Self/Other Organization in Human Psychological Development*, in: «Development and Psychopathology», vol. IX, n. 4, 1997, pp. 653-677; H. ALS, *Developmental Care in the Newborn Intensive Care Unit*, in: «Current Opinion in Pediatrics», vol. X, n. II, 1998, pp. 138-142.
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