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Comment

Social dimensions of pain
Comment on "Facing the experience of pain: A neuropsychological perspective" by Fabbro and Crescentini

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In this issue, Fabbro and Crescentini [1] provide an integrative review of neuroscientific, psychological, cultural and philosophical aspects of pain experience and discuss some critical examples of its regulation. Here we focus on the two main social phenomena that are addressed in the review, namely the 'pain of separation' and 'empathy for pain' and further support the idea that these phenomena are intrinsically linked to physical pain, which may provide a 'proximal' physiological base to further understand them. In addition, we discuss the evolutionary 'ultimate' bases of such phenomena and suggest that they are linked to the evolution of parental care in social animals and as such support the development of social bonds. We conclude by considering the effect that positive social relationships and empathy have on the experience of pain.

The distinction between proximate and ultimate causes of behavior is widely accepted in biology and refers to the distinction between questions concerning the 'how' an organism implements a target behavior and 'why' evolution has selected that behavior. According to Mayr "proximate causes govern the responses of the individual (and his organs) to immediate factors of the environment while ultimate causes are responsible for the evolution of the particular DNA code of information with which every individual of every species is endowed" [2]. Emerging neuroscientific evidence suggests that the pain of separation relies on some of the same neurochemical (e.g. opioid system) and neural substrates (e.g. anterior insular and cingulate cortices) that underlie the experiences of physical pain [3,4]. It has been suggested that such an overlap would be evolutionarily adaptive. Feeling the pain of separation is thought to support attachment and parental care during early development of social animals. As Fabbro and Crescentini point out in their review [1], attachment systems exploit the well-developed physical pain systems to maintain proximity and avoid separation, borrowing the aversive signals associated with noxious stimuli to indicate when relationships are threatened, like in the case of early separations of baby mammals from caregivers [5–7]. Similar aversive signals are thought to underlie other forms of social pain – which can be defined as the unpleasant experience that is associated

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with actual or potential damage to one's sense of social connection or social value (owing to social rejection, exclusion, negative social evaluation or loss) – in later phases of development [4,5]. Just as the physical pain system alerts an individual to the presence of a potential threat to the body and triggers physiological and behavioral reactions to cope with physical threats [8–11], social pain system alerts the individual to potential threats in social environment and recruits coping resources to minimize such a threat [3,4]. In baby mammals, separation triggers a series of signals (e.g. distress vocalizations) that can be quickly detected by the caregiver through empathic abilities (or their precursors). Sensing offspring distress in turn promotes parental care, including nurturing and comforting, consolidation of attachment, and ultimately increases the offspring's chance of survival and successful reproduction [3,12].

Thus, feeling and communication of physical and social pain are also intrinsically intertwined with empathic abilities. Empathy may have a phylogenetic and ontogenetic basis in the emotional linkage between offspring and caregivers, but it is then exercised across the entire lifespan of many mammals [6,12]. Whereas full blown empathic abilities in human primates (and possibly in apes) allow cognitive and emotional understanding of others, empathy also has evolutionary precursors that enable animals to share emotional states, even in the absence of understanding the source and causality of the aroused emotion in the other or the ability to distinguish between self and other (so-called 'emotional contagion') [6,12]. Empathy for pain entails the vicarious activation of pain signals in oneself when seeing others in pain. A large body of research indicates that watching conspecifics in a physically painful condition represents an emotionally distressing experience which is typically associated with the activation of several brain regions including the emotional [13,14], motor [15,16] and somatosensory [17,18] areas involved in the affective and sensorimotor components of physical pain. In a similar vein, perceiving others experiencing social pain can also activate physical pain circuits in the perceiver [19,20]. These findings have led to the proposal that the perception of others in pain automatically triggers the sharing of bodily and emotional pain representations between the self and other [12,21–25]. This recruitment of pain systems during the vicarious experience of others' pain is reminiscent of the 'resonant' (mirror-like) activation of motor and emotional areas during observation of others' actions and emotions [21–24,26–31]. The resonant activation of first-hand pain representations may provide a neural mechanism for empathy, at least for its 'bottom-up', automatic and rudimentary 'experience sharing' components that can also be found in non-human mammals [12,21–25,32]. Moreover, it can in part explain why others' pain and distress can trigger in the empathizer the prosocial motivation of alleviating that pain (called sympathy) [12,25,33].

From an evolutionary perspective, there is a tendency (over evolutionary time) towards more complex forms of parental care that are predominantly noticeable in mammals and to a lesser extent in birds [33]. Scholars have proposed that social pain and empathy-related phenomena have evolved in combination with parental care in social animals [6,12,33]. In this vein, motivational systems driving the pain of separation and empathic abilities were selected as tools to increase offspring survival in species that provide extensive parental care. It is important to consider that parental empathic behavior prepares offspring for their role as parents allowing the development of parenting skills [33,34]. Moreover, beyond these skills, early experiences also shape the way adult individuals interact with others emotionally. The transfer of empathic behavior to non-kin relationships may also have reproductive advantages, if one cares for non-related in-group members as if they were kin [35]. Thus, the mechanisms underlying social pain and empathy evolved in conjunction with parental care and were co-opted and used in the service of facilitating cooperation, cohesion and positive relationships between unrelated members of close-knit social groups, and ultimately to increase survival and reproduction of in-group members [6,12]. This also implies a bias in empathic reactivity towards members of one's own in-group relative to out-group members [36–38], although at least in humans, cultural influences, familiarization and cognitive flexibility allows this bias to be overcome [39,40].

In their review, Fabbro and Crescentini suggest that expectation and extensive training associated with mindfulness meditation may help in dealing with pain [1]. While we recognize that perception of pain and other negative feelings can be reduced through the engagement of various regulatory processes (ranging from behavioral avoidance or escape, to attentional distraction, cognitive reappraisal and attempts to inhibit overt responses) [41,42] and that meditation practice may promote the mindful acceptance of one's own pain and reduce its perception [1,43,44], here we also propose the role of social bonds in pain regulation. We lend further support to our focus on the social dimensions of pain by highlighting one implication of the conspicuous overlaps between physical pain, social pain and empathy: i.e., the latter phenomena can affect the former. For example, experiences of failure and social exclusion are related with increased physical pain sensitivity [4,45], but most importantly, perception of social support and empathy in significant others is associated with feeling less pain across a number of different conditions [46] and studies have begun to provide causal evidence of social support on experimental pain [47]. Interestingly, one key component of psychological wellbeing in these conditions appears to be the mindful acceptance of pain both in the person in pain and his/her spouse [43,48]. Thus, although a well-known aphorism of Paul MacLean suggests that "a sense of separation is a condition that makes being a mammal so painful" [49] appears to be grounded in the architecture and evolution of the mammalian brain, we note that empathy and interpersonal relationships with significant others have the power to alleviate the social and physical pain of being a mammal.

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