Chapter

Empathy for Pain

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Abstract

Empathy is essential for being human for understanding and sharing other people's affective and mood, including pain. Pain empathy is a mental ability that allows one person to understand another person's pain and how to respond to that person effectively. The same neural structures as pain and empathy have recently been found to be involved in functional magnetic resonance imaging (fMRI) studies. When someone witnesses other's pain, besides the visual cortex, various parts of the nervous system activate, including the neural network of empathy. Empathy includes not only pain but also other emotions, such as anger, sadness, fear, distress. These findings raised beg the question of whether empathy for pain is unique in its neural correlates. It is essential to know for revealing empathy is a specific context or in a state of chronic pain, depression or anxiety disorders. Because of this, pain empathy has been the central focus of empathy research in social neuroscience and other related fields, highlighting the importance of empathy for pain in daily life. Considering how pain plays a crucial role in the quality of life, determining its network and neurocognitive correlations in the empathy processing may provide a novel therapeutic approach for pain management. This area, which is still under investigation, can provide new information about pain. Under the recent studies and hypothesis, we have aimed to clarify the term of pain empathy, its components, and its neural correlates.

Keywords: pain empathy, functional magnetic resonance imaging, pain, empathy

1. Introduction

1.1 Empathy for pain

Empathy is a crucial component of social interactions allowing not only understand and feel other's emotions but also promoting prosocial behaviour which is vital for our social life [1–3]. Most definitions of empathy based on empathy are about a capacity of sense of knowing another person's personal experience [4]. Empathy in the context of pain has been attracted since observing somebody in pain activates similar neurons as if the observer were feeling pain himself [5, 6]. The effect of experience and observing of pain bring an interpersonal interaction in observers.

Facing the pain of others might result from ignoring to comfort or help. Having personal pain experiences facilitate to reveal empathic responses when observing someone in pain [6]. Also, sharing emotional experiences with friends may promote empathy [7]. Personal beliefs about pain may affect the level of empathy in that person [8].

Additionally, personal identity was positively correlated with empathy in nurses, doctors, and teachers. Studies have shown successful teaching requires the link between cognitive and affective empathy [9]. Empathy promotes students' academic achievement and teachers' professional growth [10, 11]. Empathy was negatively correlated with a burnout in the nursing profession [12]. Furthermore, a 10-week empathy training experiment in nurses showed significantly improved professional identity [10].

As summed above pain empathy is influenced by several factors, such as personal identity [13, 14], gender [15], attention [15, 16], prosocial characteristics, and attitude [17]. Besides these, some neuropsychiatric disorders such as schizophrenia, psychopathy, and autism may lead to impaired empathic reactions. These individuals are less responsive to their pain and others [18, 19].

Sex differences are another affecting factor in empathy for pain. Women reported more significant empathic concern and affective distress via Empathy for Pain Scale in pain compared with men [20].

Regarding contextual influences in daily life, developing a sense of knowing another person's experience in pain has been affected by several factors, such as observer's learning experiences, shared knowledge, and observed person's pain expressions, etc. All elements contribute to more or less person's affective responses as well as behavioural responses. So, a person's reaction to what they see is not identical. Although there are different mentions on the core components of empathy, there is a consensus in the literature that empathy takes a multiple and interacting process between cognition, distinction and affective state of the person.

This pain empathy process occurs from observing the pain because of his/her sense of knowing of the other's personal experience and his/her affective response to this. In this context, empathy has divided into the three-part: firstly, cognitive/evaluative part is similar to mentalising and theory of mind, ability to identify, and understand other people's emotion [21]. Second, the distinction is distinguishing of self pain from someone else's pain. The last part is pointing that sharing of the other person's affective state (which refers to the catching and automatic mimicking of other people's emotions) [22].

Successful internal balancing of empathy parts provides increased intimacy and closeness to other's emotions. So, a mother may sense a child's pain, understand the child's feelings and may kiss the wound. In an unsuccessful situation for differentiating cognitive and affective part in empathy may cause to observer's distress and burnout [8]. Finally, it would be sensible to assume that successful regulating our own emotions provide reliably use them to assess the content and sense of others' feelings correctly.

2. Evaluation of empathy for pain

Pain is a subjective term, and individuals mostly use this term through their previous experience related to the injury. When a person receives cues that another person is in pain, neural pain networks within the brain are activated, and one observing another's pain experience embodied empathic reactions such as distress. Several cues can communicate pain to another person: visualisation of the injury causing event, the injury itself, the injured's behavioral efforts to avoid further harm, and displays of pain and distress such as facial expressions, crying, and screaming [23]. To standardise and measure the empathic responses "*Empathy for Pain Scale (EPS)*" has been developed [24]. In this questionnaire, four painful scenarios are using 12 identical items rated on a scale ranging from 1 to 5 points (1 = strongly disagree; 5 = strongly agree. The scenarios are: (1) a person undergoing a surgical procedure (e.g., on the television hospital drama); (2) a person who has a surgical procedure (e.g., with stitches or bandaged amputation stump); (3) a person who is accidentally injured (e.g., in a car accident); and (4) a person who is physically assaulted. The 12 response items are distress, discomfort, disgust, fear, restlessness, sense of compassion, sense of what it feels like, a need to get help, a desire to look away, non-painful sensations, painful sensations and visceral sensations (e.g., nausea). *Interpersonal Reaction Index (IRI)* is also used as a measurement tool for evaluating empathic reactions. The tool is self-report comprising 28-items answered on a 5-point Likert scale ranging from "Does not describe me well" to "Describes me very well" [25]. The four subscales are:

1. *Perspective Taking* – the tendency to spontaneously adopt the psychological point of view of others.

2. *Fantasy* – taps respondents' tendencies to transpose themselves imaginatively into the feelings and actions of fictitious characters in books, movies, and plays.

3. *Empathic concern* – assesses "other-oriented" feelings of sympathy and concern for unfortunate others.

4. *Personal distress* – measures "self-oriented" feelings of personal anxiety and unease intense interpersonal settings.

3. Neural network for pain empathy

With the improvements in functional brain neuroimaging, most studies have focused on activity patterns and neural networks of empathy for pain [6, 26–28].

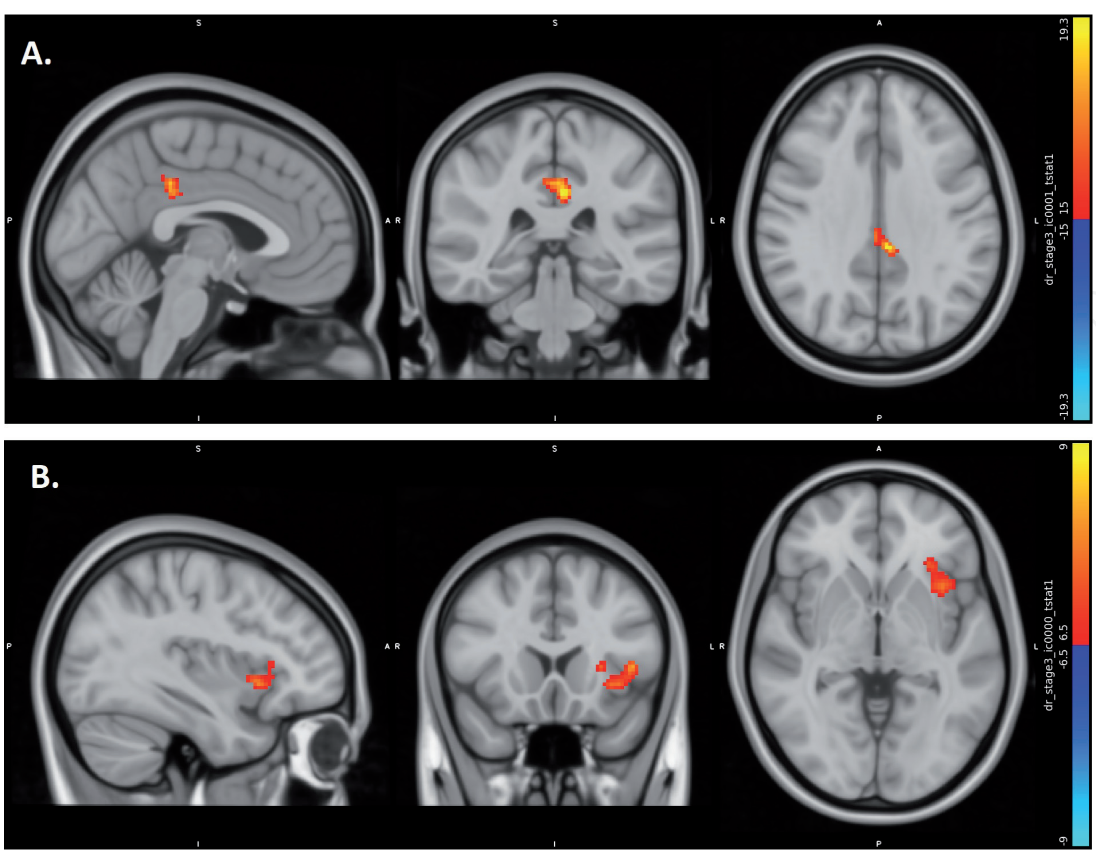

Figure 1.
(A) Mid-cingulate cortex (MMC) and (B) anterior insula (AI) are most impressed areas in empathy for pain studies.

Since early functional neuroimaging studies, the revealing of the same nervous system activation in the case of first-hand pain with responses to pain in others has prompted researchers to explore empathy for the pain core. In these studies, compared with experienced vs. observed pain, experiencing pain activates more extensive regions (with a posterior gradient) than observing pain [29]. Left mid-cingulate cortex (MMC) and left anterior insula (AI) were most impressed two regions in empathy for pain studies (**Figure 1**) [28–30], and pointed regions were also activated by the physical experience of pain [28, 31, 32]. A comprehensive study systematic search from 128 functional brain imaging studies has been confirmed neural correlates of empathy has a core network comprising AI, MCC, postcentral gyrus, inferior parietal lobe, thalamus, amygdala, and brainstem (**Table 1**) [26].

Even though there was considerable overlap in networks for pain empathy and empathy for non-pain negative affective states, empathy for pain uniquely activated bilateral mid-insula and more extensive MCC [30]. Also, activated areas of empathy network showed differentiation with the type of stimuli in the brain. While the core empathy regions evoked with painful faces and pain inflictions, acute pain inflictions also activated additional regions, including medial frontal and parietal cortex [26]. A meta-analysis of neuroimaging studies on the role of visual information indicated that individuals have different activated area response to three factors: visual cues (body parts, facial expressions), visuospatial (first-person, third-person), and cognitive (self-, stimuli-, other-oriented tasks) perspectives [33]. Body-parts distinctly activated sensorimotor processing areas (superior and inferior parietal lobules, anterior insula) while facial expression distinctly involved the inferior frontal gyrus. They have concluded that pain empathy relies on a core network which is modulated by several secondary networks [33]. This second system may contribute to process depending on the visual cues available and the observer's mental state. When we consider the pain for empathy has a quite complex mood, and network, the existing of undefined secondary structures would not be surprised.

The differentiation of activated regions has also been observed in the types of empathy. Although perceptual/affective and cognitive/evaluative parts of empathy show similar neural circuitry, cognitive/evaluative paradigms activated more left MCC regions while perceptual/affective paradigms activated more right AI (**Table 2**) [34]. The studies with paracetamol show that it might decrease psychological reactivity and alter the pain empathy in healthy human subjects [35, 36]. Paracetamol was altering specifically the affective part while keeping the cognitive part of empathy largely intact in healthy subjects. These findings mean that paracetamol reduces the emotional response to other people's negative pain experiences without affecting the pain's mentalising and internalisation. Inconsistent with this, one study suggested that paracetamol increased state empathy scores with activation of paracingulate

Anterior insula (AI)
Mid-cingulate gyrus (MCC)
Postcentral gyrus
Inferior parietal lobe
Thalamus
Amygdala
Brainstem

Table 1.
The neural correlates of empathy.

Affective-perceptual empathy	Cognitive empathy
Right ACC	Left OFC
Right DMT	Left MCC
Midbrain	Left DMT
Right AI	Left AI*
Left AI*	

Dorsal anterior cingulate cortex (dACC), anterior mid-cingulate cortex (aMCC), dorsal medial thalamus (DMT), orbital frontal cortex (OFC), anterior insula (AI).
**Region that involved in both types of empathy.*

Table 2.
The differences in regions are activated in cognitive–evaluative and affective–perceptual empathy [34].

gyrus is responsible for the processing of cognitive empathy in headache group [37]. The researchers concluded this paradigm that pain experience related adaptive brain changes might be strongly linked to the cognitive part of empathy, and targeting pain-induced empathetic neuroplasticity pathways could be a novel treatment strategy for the development of novel painkillers [37].

As we mentioned in pain empathy part, balancing of emotions provides us respond effectively and adaptively to the environmental factors. Otherwise, empathy could be destructive and unhelpful for us. Usually, individuals use to regulate their emotions with cognitive reappraisal. For example, a recent study demonstrated the exaggerated individuals' emotional pain empathy intensity, if the judgement of pain made after the participant's pain experiences as a cognitive bias. But, that bias disappeared when participants used reappraisal to regulate their empathy [38]. The emotion regulation, and mainly reappraisal-based downward regulation, is associated with executive control and limbic networks, namely the prefrontal cortex and the amygdala [39, 40]. A study compared activated region with fMRI for empathising with painful *vs* non-painful scenarios as well as for reappraising painful *vs* non-painful scenarios. Empathising with painful scenarios was associated with increased connectivity with the mid-cingulate and anterior cingulate cortex (ACC), as well as with the bilateral post-central cortex [41].

Conversely, during reappraisal of painful *vs* non-painful scenarios, increased connectivity was found between the inferior frontal gyrus (IFG) and the bilateral lateral occipital cortex, as well as with the left IFG, left posterior insula and left parahippocampal gyrus. Interestingly, different regulation strategies resulted in increased connectivity with other parts of the network. Empathic watch resulted in increased connectivity with regions involved in the processing of self-pain. In contrast, reappraisal resulted in increased connectivity with regions involved in the simulation of other pain, as well as self-pain processing [42]. Activation in the left supramarginal gyrus (SMG) and the right middle frontal gyrus (MFG) was found during empathic watch only, suggesting that these two regions play a critical role and are associated with the process of feeling empathy for the pain of others [41].

4. Conclusion

In line with getting raising numerous study, it could simplify the role of empathy for pain based on a matching of psychological states between the sufferer and the observer. This matching contributes to prosaically actions, affective sharing, emotion regulation, and provide to alleviating the pain and suffering of others.

Under the light of empathy for pain studies, it should be indicated that the neural networks of empathy for pain have not still exactly clarified yet.

Whether the underlying processing of empathy for pain/pain empathy is associated with other non-pain negative affective states still needs more investigation. This gap mentioned-above is particularly relevant for studying empathic responses in different contexts, with diverse populations (age, sex, culture, vocation, etc.) and other affective/sensory states. In the context of the crucial role of pain in the quality of life, empathy for pain deserves more experimental studies for effective pain management in people suffering intractable pain attacks. This chapter discusses not only the definition of empathy for pain, but also the importance of its brain -network correlates, and the ability to empathise with pain in others. Future studies are required for revealing the essential components of pain empathy by different pain stimuli and paradigms.

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