A Social-Neuroscience Perspective on Empathy

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ABSTRACT—***In recent years, abundant evidence from behavioral and cognitive studies and functional-imaging experiments has indicated that individuals come to understand the emotional and affective states expressed by others with the help of the neural architecture that produces such states in themselves. Such a mechanism gives rise to shared representations, which constitutes one important aspect of empathy, although not the sole one. We suggest that other components, including people's ability to monitor and regulate cognitive and emotional processes to prevent confusion between self and other, are equally necessary parts of a functional model of empathy. We discuss data from recent functional-imaging studies in support of such a model and highlight the role of specific brain regions, notably the insula, the anterior cingulate cortex, and the right temporo-parietal region. Because this model assumes that empathy relies on dissociable information-processing mechanisms, it predicts a variety of structural or functional dysfunctions, depending on which mechanism is disrupted.***

KEYWORDS—*empathy; intersubjectivity; affective sharing; perspective taking; emotion regulation*

Empathy refers to the capacity to understand and respond to the unique affective experiences of another person. At an experiential level of description, this psychological construct denotes a sense of similarity between one's own feelings and those expressed by another person. At a basic level of description, empathy can be conceived of as an interaction between any two individuals, with one experiencing and sharing the feeling of the other. This sharing of feelings does not necessarily imply that one will act or even feel impelled to act in a supportive or sympathetic way. The social and emotional situations eliciting empathy can be quite complex, depending on the feelings experienced by the observed person (target), the relationship of the target to the observer, and the context in which they socially interact.

In recent years, there has been a growing interest in the cognitive-affective neuroscience of empathy. In this article, we first discuss what the components of this psychological construct are and then present empirical data that can cast some light on the neurocognitive mechanisms subserving empathy, with a special emphasis on the perception of pain in others.

THE MAJOR COMPONENTS OF EMPATHY

Despite the various definitions of empathy, there is broad agreement on three primary components: (a) an affective response to another person, which often, but not always, entails sharing that person's emotional state; (b) a cognitive capacity to take the perspective of the other person; and (c) emotion regulation. Some scholars favor a particular aspect over the others in their definitions. For instance, Hoffman (1981) views empathy as a largely involuntary vicarious response to affective cues from another person, while Batson et al. (1997) emphasize people's intentional role-taking ability, which taps mainly into cognitive resources. These two aspects represent the opposite sides of the same coin: Depending on how empathy is triggered, the automatic tendency to mimic the expressions of others (bottom-up processing) and the capacity for the imaginative transposing of oneself into the feeling and thinking of another (top-down processing) are differentially involved. Moreover, both aspects tap, to some extent, similar neural mechanisms that underpin emotion processing. It is unlikely, however, that the overlap between self- and other representations is absolute. Such a complete overlapping between self and other could lead to personal distress (i.e., a self-focused, aversive response to another's emotional state). This would consequently hamper the ability to toggle between self- and other perspectives and would not constitute an adaptive behavior. Therefore, self-regulatory processes are at play to prevent confusion between self- and other feelings.

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Affective Sharing Between Self and Others

A number of theorists have pointed out that empathy involves resonating with another person's unconscious affect and experiencing that person's experience along with him or her while keeping one's own self-integrity intact. Notably, Basch (1983) speculated that, because their respective autonomic nervous systems are genetically programmed to respond in a like fashion, a given affective expression by a member of a particular species sometimes triggers a similar response in other members of that species.

The view that unconscious automatic mimicry of a target generates in the observer the autonomic response associated with that bodily state and facial expression subsequently received empirical support from a variety of studies as well as observations from ethologists (Preston & de Waal, 2002). For instance, viewing facial expressions triggers similar expressions on one's own face, even in the absence of conscious recognition of the stimulus. It was proposed that people may "catch" the emotions of others as a result of feedback generated by elementary motor mimicry of others' expressive behavior, producing a simultaneous matching emotional experience. Interestingly, Levenson and Ruef (1992) found that a perceiver's accuracy in inferring a target's negative emotional states is related to the degree of physiological synchrony between the perceiver and the target. In other words, when the physiological state (e.g., heart rate, muscle activity) of two individuals is more closely matched, they are more accurate at perceiving each other's feelings.

Recently a functional magnetic resonance imaging (fMRI) experiment confirmed these results by showing that when participants are required to observe or to imitate facial expressions of various emotions, increased neurodynamic activity is detected in the brain regions that are implicated in the facial expression of these emotions, including the superior temporal sulcus, the anterior insula, and the amygdala, as well as specific areas of the premotor cortex (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003). The similarity between the expression of an emotion and the perception of that emotion has also been demonstrated for disgust. Damage to the insula, a region crucial in monitoring body state, can impair both the experience of disgust and the recognition of social signals (e.g., facial and emotional expression) that convey disgust. Functional neuroimaging studies (see Decety & Jackson, 2004, for review) have later shown that observing facial expressions of disgust and feelings of disgust activated very similar sites in the anterior insula and anterior cingulate cortex (ACC).

Altogether these results point to one basic mechanism for social interaction: the direct link between perception and action. Such a system automatically prompts the observer to resonate with the emotional state of another individual, with the observer emulating the motor representations and associated autonomic and somatic responses of the observed target (Preston & de Waal, 2002). This covert mimicry process is responsible for shared affects and feelings between self and other. Developmental research has demonstrated that motor and affective mimicry are active already in the earliest interactions between infants and caregivers, raising the possibility that these processes are hardwired.

The expression of pain provides a crucial signal that can motivate helping behaviors in others. Finding out how individuals perceive others in pain is thus an interesting way to decipher the underlying neural mechanisms of empathy. Recently, a handful of fMRI studies have indicated that the observation of pain in others is mediated by several brain areas that are implicated in processing the affective and motivational aspects of one's own pain. In one study, participants received painful stimuli and observed signals indicating that their partner, who was present in the same room, had received the same stimuli (Singer et al., 2004). The rostral (or anterior) ACC, the insula, and the cerebellum were active during both conditions. In another study, participants were shown photographs depicting body parts in painful or neutral everyday-life situations, and were asked to imagine the level of pain that these situations would produce (Jackson, Meltzoff, & Decety, 2005). In comparison to neutral situations, painful conditions elicited significant activation in regions involved in the affective aspects of pain processing, notably the ACC and the anterior insula. Moreover, analyses taking into account the behavioral responses of participants revealed that the level of activity within the ACC correlated with ratings of pain that subjects ascribed to the different situations. This finding strongly suggests that this region plays a crucial role in affective modulation, which is triggered by the assessment of painful situations. Altogether, these results lend support to the idea that common neural circuits are involved in representing one's own and others' affective pain-related states (Fig. 1).

Adopting the Perspective of the Other

Humans have the capacity to intentionally adopt the subjective perspective of others by putting themselves into other people's shoes and imagining what they feel. Such a capacity requires that one mentally simulate the other's perspective using one's own neural machinery. In one neuroimaging study, the participants were presented with short written sentences that depicted real-life situations likely to induce social emotions (e.g., shame) or other situations that were emotionally neutral (Ruby & Decety, 2004). Participants were each asked to imagine how they would feel if they were in those situations and how their mothers would feel in the same situations. Regardless of the affective content of the situations depicted, when the participants adopted their mothers' perspective, activation was detected in the frontopolar cortex, the ventromedial prefrontal cortex, the medial prefrontal cortex, and the right inferior parietal lobule—congruent with the role of these regions in executive functions associated with the perspective-taking process (Fig. 2). Regions involved in emotional processing, including the amygdala and

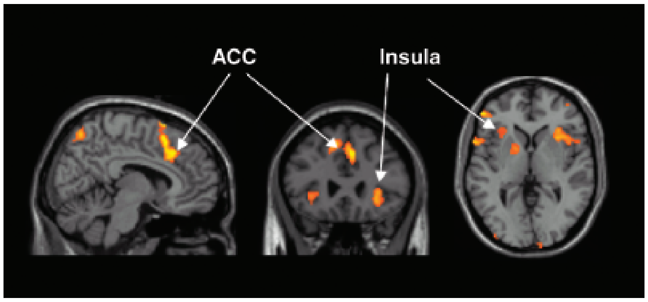

Fig. 1. Sagittal (left), coronal (middle), and horizontal (right) views of activation sites in the anterior cingulate cortex (ACC) and insula elicited in individuals watching pain in others. Physiological research in pain processing indicates that the ACC plays a role in the affective dimension of pain, particularly those related to behavioral responses associated with avoiding or escaping a painful stimulus. This region combines attentional and evaluative functions with that of establishing emotional valence and response priorities. The insula is involved in monitoring the physiological state of the body. It receives direct input from the body's major pain pathway. Interestingly, both the ACC and the insula are found to be activated by the mere sight of pain in others.

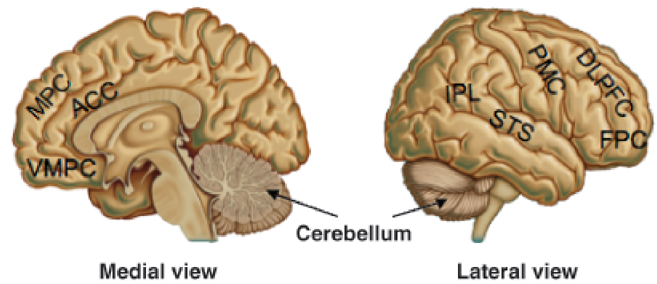

Fig. 2. Anatomical and functional regions of the brain mentioned in the text. The superior temporal sulcus (STS) is the most dorsal (highest) region of the temporal lobes located under the fissure that separates the frontal and temporal lobes. The premotor cortex (PMC) is a region of the frontal lobes anterior to the motor cortex on both lateral (side) and medial (inner) surfaces of the brain. The anterior cingulate cortex (ACC), located on the inner surface of the hemispheres, appears to play a role in a variety of autonomic functions, such as regulating heart rate and blood pressure, and is vital to cognitive functions and emotion regulation. Anterior to the PMC is the prefrontal cortex, which is functionally divided into several regions: the dorsolateral (DLPFC), the ventrolateral (referring to the higher and lower portion of the area located on the lateral surface of the brain), and the medial prefrontal cortex (MPC) which is located on the inner surface of the frontal lobes; its lowest portion is often called the ventromedial prefrontal cortex (VMPC). The frontopolar cortex (FPC), the most anterior portion of the frontal lobes, is considered to mediate executive functioning, monitoring and controlling thought and actions—including self-regulation, planning, cognitive flexibility, response inhibition, and resistance to interference. There is increasing evidence to suggest that the right inferior parietal lobule (IPL), the lower part of the parietal lobes, plays a pivotal role in distinguishing the perspectives of the self from those of others, an ability that is relevant to knowing that the contents of other people's minds can be different from one's own.

the temporal poles, were activated in conditions that involved situations that were emotion-laden for both self and other. This study indicates that self- and other-oriented emotional judgments commonly make use of regions implicated in emotion processing, and supports the idea that the imaginative transposing of oneself into the subjective world of another person taps neural circuits shared between people.

In a new fMRI study, participants were shown pictures of people with their hands or feet in painful or nonpainful situations and were instructed to imagine themselves or imagine another individual in the same scenarios. Participants then had to rate the level of perceived pain according to the different perspectives (Jackson, Brunet, Meltzoff, & Decety, 2006). Both the self- and the other perspectives were associated with activation in the neural network involved in pain processing—including the parietal operculum, the ACC, and the anterior insula. However, the self-perspective yielded significantly higher pain ratings and activated the pain matrix more extensively, reaching within the secondary somatosensory cortex, the posterior part of the ACC, and the insula proper—consistent with the pattern of activity detected in firsthand experience of pain.

These studies point out the similarities between self and other regarding neural-network activation during pain perception that are consistent with the shared-representations account of social interaction. However, the findings also highlight important differences between self and other predicted by our model. For instance, while the insula activated when participants imagined the pain of self and others, different nonoverlapping clusters within that region were activated for the two tasks. Likewise, both self- and other perspectives are associated with a common sub-area in the ACC, but self-perspective selectively activated another part of this region, in which neurons coding specifically for pain have been documented.

Self-Agency and Emotion Regulation

Thus, whether one witnesses another individual's emotional state or consciously adopts that person's psychological view, similar neural circuits are activated in the self. These findings fit neatly with the simulation theory, which states that behavior can be simulated by activation of the same neural resources for acting and perceiving (Goldman, 2006). However, a complete overlap between self- and other representations could induce emotional distress or anxiety, which is not the function of empathy. In the experience of empathy, individuals must be able to disentangle themselves from others. This distance is a key characteristic in psychotherapy. Therefore, agency is a crucial aspect of empathy. Affective sharing must be modulated by maintaining a sense of whose feelings belong to whom. It has been proposed that nonoverlapping parts of the neural circuit mediating shared representations (i.e., the areas that are activated for self-processing and not for other processing) generate a specific signal for each form of representation. There is strong evidence from fMRI studies, as well as from lesion studies in neurological patients, that the right temporo-parietal junction plays a critical role for the sense of self-agency (Decety & Sommerville, 2003). It is worth noting that adopting the perspective of another person to imagine his or her emotional reactions (Ruby & Decety, 2004) or to imagine his or her pain (Jackson et al., 2006) was associated with specific increase in the posterior cingulate and precuneus, as well as in the right temporo-parietal junction. These areas are reliably involved in distinguishing the perspective of the self from that of others in a variety of tasks involving actions and emotions. These areas contribute to the sense of agency and self-awareness by comparing self-generated signals to signals from the environment. We argue that this neurocognitive mechanism plays a pivotal role in empathy. Its contribution to social interaction may distinguish emotional contagion, which heavily relies on the automatic link between perception of another person's expressed emotions and one's own experience of the same emotions, and empathy, which necessitates a more detached relationship.

Finally, being aware of one's own emotions and feelings enables one to reflect on them. It has been demonstrated that individuals who can regulate their emotions are more likely to experience empathy and to act in morally desirable ways with others (Eisenberg, Smith, Sadovsky, & Spinrad, 2004). Among various emotion-regulation strategies, reappraisal by denial of relevance (i.e., taking a detached-observer position) by generating an image of the observing self unaffected by the target is known to reduce the subjective experience of anxiety, sympathetic arousal, and pain reactivity. Such a strategy is likely to play an important role in empathy, in order to maintain a detached perspective with the target (for example, a psychotherapist and a client). Recent fMRI studies have identified a limited number of regions in the anterolateral and medial prefrontal cortices that mediate such function (e.g., Kalisch et al., 2005). More research is needed to determine how the neural system subserving emotion regulation modulates (or inhibits) the other components that are involved in empathy, notably the automatic emotional mimicry.

CONCLUSIONS

There is strong evidence that, in the domain of emotion processing and empathic understanding, people use the same neural circuits for themselves and for others. These circuits provide a functional bridge between first-person and third-person information, which paves the way for intersubjective transactions between self and others. These circuits can also be activated when one adopts the perspective of the other. However, were this bridging between self and other absolute, experiencing another's distress state as one's own experience could lead to empathic overarousal, in which the focus would then become one's own feelings of stress rather than the other's need. Self-agency and emotion-regulatory mechanisms thus play a crucial role in maintaining a boundary between self and other.

A better knowledge of the mechanisms involved in empathy will have important implications for the examination and understanding of individuals with social cognitive disorders. Likewise, the absence of empathy in certain neurological and psychiatric disorders, including autism and narcissistic and antisocial personality disorders, may also provide important clues about the relevant brain circuitry underlying affective sharing and empathy. People may indeed lack empathy for various reasons. For instance, emotion sharing or emotion regulation may be impaired in antisocial personality disorder. In contrast, people prone to personal distress may present deficits in self–other distinctiveness. Finding out that these empathy deficits (which are all expressed differently) stem from impairment in distinct neural networks or interaction between them will add to a comprehensive model of empathy and may even guide intervention and treatment strategies in the clinical arena.

Recommended Reading

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