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Empathy: A Social Cognitive Neuroscience Approach

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Abstract

There has been recent widespread interest in the neural underpinnings of the experience of empathy. In this review, we take a social cognitive neuroscience approach to understanding the existing literature on the neuroscience of empathy. A growing body of work suggests that we come to understand and share in the experiences of others by commonly recruiting the same neural structures both during our own experience and while observing others undergoing the same experience. This literature supports a simulation theory of empathy, which proposes that we understand the thoughts and feelings of others by using our own mind as a model. In contrast, theory of mind research suggests that medial prefrontal regions are critical for understanding the minds of others. In this review, we offer ideas about how to integrate these two perspectives, point out unresolved issues in the literature, and suggest avenues for future research.

In a way, most of our lives cannot really be called our own. We spend much of our time thinking about and reacting to the thoughts, feelings, intentions, and behaviors of others, and social psychology has demonstrated the manifold ways that our lives are shared with and shaped by our social relationships. It is a marker of the extreme sociality of our species that those who don't much care for other people are at best labeled something unflattering like 'hermit', and at worst diagnosed with a disorder like 'psychopathy' or 'autism'. Successfully navigating our highly social environment requires a brain that is superbly evolved to process this type of complex and subtle information and to orchestrate appropriate responses (Dunbar, 1998). The relatively new field of social cognitive neuroscience has developed in an effort to understand how our brains accomplish this rather astounding feat (Lieberman, 2007).

In recent years within the field of social cognitive neuroscience, there has been increasing interest in the neural mechanisms that underlie the psychological experience of empathy. This enthusiasm is partly due to the fact that empathy, in some sense, cuts right to the heart of what it means to be human: we are capable of not only recognizing the joys and sorrows of others, but also of reflecting on and sharing in the experience of those emotions. Such participation in the experiences and emotions of others is also thought to be an important motivator of altruistic behavior (Batson, 1991). Furthermore, the construct of empathy has been the focus of considerable research interest because a lack of empathy is characteristic of many different kinds of mental disorders (Farrow & Woodruff, 2007).

In its broadest characterization, the neuroscience of empathy is concerned with how the brain represents, understands, and reacts to the internal mental states of others. However, providing a more specific, agreed-upon definition of empathy is fraught with complications. The construct itself, although thought to be critical to social functioning, has eluded consensus regarding its key features. Some views emphasize the affective component of empathy, or the matching of affective experience between a participant and a target individual. Other researchers have focused more on the cognitive component of empathy, which is concerned with the ability to take the perspective of others. This has been called 'everyday mindreading', and it tends to focus primarily upon the accuracy of empathic inferences (Ickes, 2003). Other researchers have suggested that empathy can most properly be thought of in terms of a dual-process model that incorporates both of these elements. In this view, empathy consists of both automatic affective experience and controlled cognitive processing, which are distinct but interrelated processes that may be instantiated differently in the brain (Decety & Jackson, 2004; Keysers & Gazzola, 2007; Shamay-Tsoory et al., 2005a; Singer, 2006).

Research in social cognitive neuroscience about how we understand the minds of others has been guided by two dominant theoretical views that are sometimes seen as being at odds with each other. Simulation theory proposes that we understand the minds of others by using our own mind as a model. By putting ourselves in the 'mental shoes' of another and simulating his or her experience in our own mind, we can intuitively understand what that experience might be like (Gordon, 1986). The discovery of mirror neurons and other 'shared circuits' that are commonly activated by one's own and another's actions have been viewed as neural evidence in support of simulation theory (Gallese & Goldman, 1998). In contrast, theory-theory suggests that we understand others through mentalizing, a more cognitive form of mindreading which tends to activate temporal and medial prefrontal structures (Gallagher & Frith, 2003; Gopnik, 1993). Our purpose here is not to provide a precise definition of the construct of empathy or endorse a particular theory of empathy, but rather to give a sense of the complexity inherent to defining and understanding the phenomenon. In this review, we will examine how these perspectives have shaped the neuroscientific investigation of empathy and discuss ideas for integrating these divergent views in future research.

Empathy and Mirror Neurons

The neural mechanisms by which affective states are matched between an observer and a target individual have been a primary focus of neuroscientific research on empathy. Such research has been strongly influenced by the perception-action model of empathy (Preston & de Waal, 2002). This model is consistent with a simulation theory of empathy and posits that perception of target's state activates the observer's own representations of that state, which then triggers autonomic and somatic responses that create an embodied emotional experience within the observer that mimics the experience of the target. In this model, empathy is viewed as an automatic, non-conscious process in which one comes to feel the emotions of another via shared mental representations. This focus on the overlapping representations of the self and others draws heavily on research done on the mirror neuron system.

In the early 1990s, researchers conducting single-cell recordings in the premotor cortex of macaques discovered a class of neurons that fired during the observation and the performance of a motor action, which suggests that both share a common neural representation (di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992; Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Rizzolatti & Craighero, 2004). Functional neuroimaging studies in humans have since demonstrated activations in areas that belong to the mirror-neuron system, namely in inferior frontal and parietal cortices (see Figure 1; Iacoboni et al., 1999; Rizzolatti et al., 1996).

Researchers have extended these findings to suggest that the mirror neuron system may be important for the experience of empathy, as non-conscious neural mirroring may allow us to vicariously experience the emotional states of others and enable the affective sharing characteristic of empathy (Decety & Jackson, 2004; Gallese, 2003; Gallese & Goldman, 1998; Iacoboni et al., 1999). Researchers have found support for this idea by showing that imitation and observation of emotional facial expressions commonly activated mirror neuron and limbic regions, including premotor cortex, inferior frontal cortex (Brodmann's area 44), superior temporal sulcus, anterior insula, and amygdala (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003). Carr et al. suggest that the insula may act as a relay station for transmitting action information from premotor mirror areas to limbic areas, which then process emotional content (Augustine, 1996). Additional support for mirror neuron contributions to empathy comes from the study of children with autism, who fail to display normal mirror neuron activity in the inferior frontal cortex during imitation of emotional expressions (Dapretto et al., 2006).

The neural overlap between the perception and execution of motor action has inspired research into whether there are similar shared circuits involved in the observation and experience of emotion. Much of this research has been done using pain as a stimulus because of its inherently salient and aversive nature. These studies generally show overlapping activations between the experience and observation of pain in regions associated with the affective, but not sensory, components of pain (but see Avenanti, Bueti, Galati, & Aglioti, 2005). For example, receiving pain and

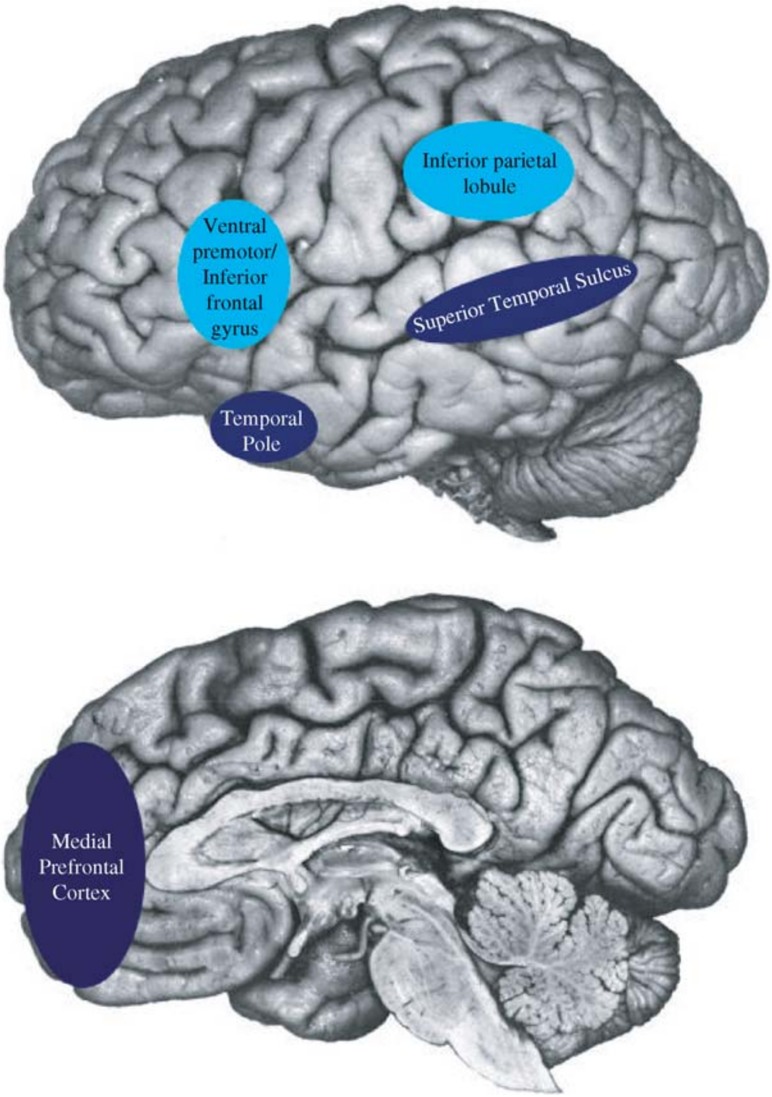

Figure 1 Ventral premotor/inferior frontal gyrus and rostral inferior parietal lobule are critical components of the human mirror neuron system. The medial prefrontal cortex, superior temporal sulcus, and temporal pole are engaged during mentalizing tasks.

watching another in pain commonly activate anterior insula and dorsal anterior cingulate, areas known to be involved in the experience of distress due to physical pain (Morrison, Lloyd, di Pellegrino, & Roberts, 2004; Singer et al., 2004). Furthermore, greater activation in these regions during observation was associated with higher levels of trait empathy (Singer et al., 2004). Because these regions are active both for the experience and the observation of pain, it may suggest that these participants were activating their own representations of pain during observation in a manner consistent with simulation theory.

Other studies have generally replicated these initial findings. For example, viewing and rating pictures of feet and hands in potentially painful situations (such as a finger placed between the blades of scissors) activates dorsal anterior cingulate and anterior insula (Jackson, Meltzoff, & Decety, 2005). Furthermore, activations in the dorsal anterior cingulate correlate with ratings of how painful the stimulus appears (Jackson, Meltzoff, & Decety, 2005) as well as trait ratings of empathy (Lamm, Batson, & Decety, 2007). Similarly, watching facial expressions of pain activate anterior insula and dorsal anterior cingulate (Botvinick et al., 2005) and ratings of the intensity of the painful expression are correlated with activity in these regions (Saarela et al., 2007).

This overlap between observation and experience has been demonstrated in other domains as well. For example, smelling something disgusting and watching someone else smell something disgusting both activate the anterior insula (Wicker et al., 2003). Similarly, the secondary somatosensory cortex is activated both when one is touched and when one observes someone else being touched (Keysers et al., 2004). This study is consistent with recent evidence for the existence of 'mirror-touch' synesthesia, in which affected individuals have difficulty distinguishing between real and observed touch (Banissy & Ward, 2007). Intriguingly, these synesthetes show higher levels of empathy compared to controls. In another recent study, activation in the gustatory cortex in response to watching pleased and disgusted faces made after food consumption were correlated with trait empathy (Jabbi, Swart, & Keysers, 2007). There is also evidence for an auditory mirror neuron system, which is active both while performing an action and while listening to the sounds of a similar action (Gazzola, Aziz-Zadeh, & Keysers, 2006).

Empathy and the Medial Prefrontal Cortex

The understanding that others have thoughts, beliefs, and emotions that may differ from our own is referred to as 'theory of mind' (Premack & Woodruff, 1978), and the metacognitive process of thinking about the contents of other people's minds is described as mentalizing (Frith & Frith, 1999). The understanding that others have an internal mental landscape that differs from our own is a critical step in development and usually comes on-line at around age 4 (Wimmer & Perner, 1983). This ability has often been tested by tasks in which participants must report the false belief of an individual whose factual knowledge differs from that of the participant. The successful completion of such tasks demonstrates the ability to distinguish between the contents of one's mind and the knowledge that is present in another's mind.

Neuroimaging studies have shown that the medial prefrontal cortex/paracingulate gyrus, superior temporal sulcus, the temporal poles, and the temporoparietal junction are all engaged for tasks that require theory of mind (see Figure 1; Amodio & Frith, 2006; Gallagher & Frith, 2003; Samson, Apperly, Chiavarino, & Humphreys, 2004). In particular, activation of the medial prefrontal cortex is extremely robust across a variety of different mentalizing tasks and it seems that this region may play a particularly important role in representing the minds of others. For example, in a study where children play 'paper, scissor, rocks', the medial prefrontal cortex is active when the participants believe they are playing against the experimenter, but not when they think they are playing against a computer (Gallagher, Jack, Roepstorff, & Frith, 2002). Similarly, medial prefrontal cortex is preferentially engaged when participants judge psychological characteristics of a target, regardless of whether the target is a person or a dog (Mitchell, Banaji, & Macrae, 2005). Furthermore, patients with lesions to the medial prefrontal cortex are impaired on false belief tasks and recognizing instances of faux pas, two very different kinds of mentalizing tasks (Gregory et al., 2002; cf. Bird, Castelli, Malik, Frith, & Husain, 2004).

While theory of mind tasks tap into propositional reasoning about the mental states of others, there has also been interest about the role of medial prefrontal cortex in understanding the emotional states of others. It has been suggested that the medial prefrontal cortex may be functionally divided such that ventral regions may be important for affective processing while more dorsal regions may be primarily involved in cognitive processes (Phillips, Drevets, Rauch, & Lane, 2003; Stuss & Levine, 2002). It is plausible that ventromedial prefrontal cortex may be important for affective aspects of empathy but may be less involved in cognitive aspects of empathy, such as reasoning about mental states (Sabbagh, 2004). Supporting this view, Hynes et al. (2006) found that compared to cognitive perspective taking, emotional perspective taking preferentially engaged ventromedial prefrontal cortex. The authors note that this finding is consistent with the lesion literature, which reports that patients with ventral prefrontal damage show impairments in emotional perspective taking. In a study of observational fear learning, the medial prefrontal cortex was selectively activated in response to the observation but not the receipt of pain, which is consistent with this region playing a role in understanding affective components of another's experience (Olsson, Nearing, & Phelps, 2007). Similarly, neuropsychological studies have shown that patients with prefrontal damage display impaired empathy, especially when damage is localized to the ventromedial area (Shamay-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003). In addition, patients with ventromedial prefrontal damage have been shown to be impaired on irony and faux pas tasks, which require affective processing, but not on false-belief tasks, which are more cognitive in nature and may depend upon more dorsal regions (Shamay-Tsoory, Tomer, Berger, Goldsher, & Aharon-Peretz, 2005b).

Empirical Issues

This fascinating and productive line of research on the social neuroscience of empathy raises a number of interesting issues. The first is one of methodology. It is somewhat surprising that none of the studies reviewed above explicitly instructed the individuals to engage (or not engage) in empathic processing. If one wishes to conclusively isolate the neural correlates of a phenomenon, it is important to know that the participants are in fact experiencing the phenomenon of interest. Therefore, studies that specifically ask participants to engage in empathic processing are needed, and a fruitful direction for future research would be to contrast neural activity in response to empathic and non-empathic instructions. If neuronal mirroring is a critical mechanism for the experience of empathy, one would expect to see such areas activate more strongly in response to empathic instructions.

Another issue concerns phenomenology. None of the studies reviewed above reported upon the emotional experience of the participants in response to the tasks. Rather, empathetic responses tend to be inferred by the presence of neural overlap between the two conditions. However, this result does not conclusively show that participants experienced empathy, or any other sort of affective response. Because the neural mechanism of empathy should correlate with its phenomenological experience, studies that correlate self-reports of empathy during the task to brain activity are needed. As of yet, brain activity has only been correlated with trait empathy. This methodology implicitly assumes trait empathy is an appropriate proxy for state empathy during the task, but this assumption remains untested.

Furthermore, it is not clear the extent to which a shared circuit model can account for displays of empathy in which the emotions of the perceiver and target are incongruent. For example, seeing a child in tears because a bully is tormenting him might stir feelings of anger in an observer (as opposed to the fear the child experiences), yet the response is surely still an empathetic one. As noted by Hoffman, empathy does not simply entail the matching of feelings, but the adoption of feelings '*that are more congruent with another's situation than with his own situation*' (2000). If perception of the target's emotion automatically triggers a similar emotion (or the precursor to this emotion) in the observer, it is unclear how these appropriate, incongruent emotional responses would come into being through utilization of neural mirror mechanisms alone.

In a similar vein, the use of congruent stimuli makes it difficult to separate out responses that are self-focused from those that are other-focused, and thus truly empathic. For example, if a participant sees a picture of a mutilated body, she may feel quite distressed by it and exhibit insula activation. If she is then told that her partner is viewing the same distressing picture, she may react in one of two ways: she might feel distressed for her partner, or she might feel distressed upon thinking about the upsetting picture. Only the first response is truly empathetic, but it is likely that both would commonly activate the insula. The methods that have been popularly employed in the neuroscientific study of empathy are unable to distinguish between these two quite qualitatively different responses. As Singer (2006) noted, the empathic response to watching a masochist receive pain should not be one of distress – it should be one of pleasure, because for the masochist, pain is pleasurable.

As an analogy, in research on theory of mind, it was recognized that to truly test the construct, the participant must hold a belief that differs from the belief of the target. If the target and the participant both hold the same belief, a correct response about the target's mental state may simply reflect the belief of the participant, rather than the participant's belief about the target. Utilizing this same logic, it will be important for future research on empathy to incorporate incongruent responses into experimental designs to ensure that participants are experiencing empathic, rather than self-focused, responses. The introduction of such designs will also help to disentangle responses of empathy and emotional contagion, which has not yet been attempted. It is important for future research in this area to consider that while emotional contagion and empathy may share certain features (such as affect matching in some cases), the two constructs are not synonymous.

Empathic Focus and Processing Mode

One possible way of integrating the body of work reviewed so far is to further consider the important roles empathic focus and processing mode play in the experience of empathy. One relevant aspect of this question is whether the individual is focused on the self or the other, as self-focus is likely to have very different emotional and behavioral consequences from other-focus. Furthermore, it seems important to distinguish between the object of one's focus and the processing mode one adopts. More specifically, we suggest that it is possible to adopt one of two general kinds of modes when processing information about the self or another individual, which we will term experiential or propositional. In this view, which recalls James's conception of selfhood (1890), experiential processing can be thought of as an automatic, affective, stream-of-consciousness experience that feels like unmediated reality (Lieberman, Gaunt, Gilbert, & Trope, 2002). For example, a self-focused experiential reaction to an upsetting event would be made up of the affective and cognitive reactions to the event that simply feels like one's experience of the event. In contrast, propositional processing can be thought of as a controlled cognitive process. Self-focused propositional processing of an upsetting event would be the metacognitive evaluation of one's thoughts and feelings in response to the event.

Importantly for the study of empathy, which should by definition be other-focused, this view suggests that one is capable of thinking about the

		Experiential	Propositional
Self-focused	Mental Event:	*Personal distress*	*Self-reflection*
	Behavioral result:	Avoidance?	Self-understanding?
Other-focused	Mental Event:	*Empathic Concern*	*Empathic Accuracy*
	Behavioral result:	Altruistic behavior? (depends on prior experience)	Altruistic behavior? (depends on prior knowledge)

Figure 2 Phenomenological experience and behavior in response to another's distress may differ depending upon processing mode and empathic focus.

experiences of other in either an experiential or propositional way. Experiential processing in this case maps very closely onto simulation theory. That is, in order to understand the experience of another, there is a way in which one can jump into that situation and experience it as though it is happening to oneself, in a very automatic way. A familiar example of this is being fully engrossed in a movie, where we can vicariously experience the mental world of the character in an other-focused manner that takes into account the target's perspective and preferences. For example, when one watches a villain brandish a firearm at Superman, one can experientially share Superman's confident, nonchalant emotional reaction. This is because of his (not our) invulnerability to bullets, but one probably does not consider this fact in a propositional manner. Thus, in this way, it is possible to maintain an other-focused orientation while employing experiential processing. In contrast, propositional processing of another's experience employs controlled reasoning about the mental states of others, which recalls theory-theories of empathy.

In this conceptualization, the object and mode of thought form a two-by-two matrix that is fully crossed (see Figure 2). The conditions under which one employs the different kinds of processing modes will likely depend upon many factors, including cognitive resources, motivation, individual differences, the nature of the relationship between target and actor, and the medium of presentation (e.g., movies are probably easier to process in an experiential manner than a news report, as is reading a novel in the first-person compared to the third). It seems likely that each quadrant represents a unique psychological experience that may hold implications for behavior. For example, adopting an experiential self-focused perspective about a negative event would likely result in personal distress and a desire to avoid the unpleasant stimulus. In contrast, adopting an experiential other-focused perspective would likely result in empathic concern, which might lead to altruistic behavior (Batson, 1991). Employing propositional, self-focused processing would likely be related to reflecting upon one's own thoughts and feelings about the experience in a metacognitive way.

Alternatively, utilizing propositional, other-focused processing would be associated with understanding the thoughts and feelings of others, which is likely to play an important role in empathic accuracy as well as altruistic behavior.

Although we argue that both empathic concern and empathic accuracy may lead to altruism, it is likely that the two experiences will give rise to qualitative differences in motivation and the types of resultant behaviors. For example, altruism resulting from empathic concern (engendered by other-focused experiential processing) is likely to be based on an affective reaction to the target's distress. In contrast, altruism arising from empathic accuracy (instantiated by other-focused propositional processing) may result more from social rules and knowledge. Furthermore, empathic concern and accuracy might also be distinguished by the kinds of altruistic behavior engendered. For example, empathic concern might motivate immediate physical engagement, while empathic accuracy might initiate more complex thinking about long-term solutions to problems that might not be immediately gratifying, but might produce systemic changes in the target's situation.

It is important to recognize the ways in which both of these processing modes interact and depend upon each other. For example, appropriate empathic concern may depend upon the ability to accurately ascertain an individual's mental state. In a simplistic example, if someone does not sense that another person is upset, it is impossible for him to feel sad for her. Moreover, engagement of one process could easily trigger or inhibit another. For instance, thinking in a propositional way about the circumstances of your friend's divorce could quickly evolve into an experiential response of sadness for your friend. Alternatively, a picture of a child crying could generate an affective response that could either be magnified or inhibited by further consideration of the child's situation and mental state. It is probable that we switch between these modes as we make sense of the world, and that the ability to understand the experiences of others in both ways is quite important to the experience of empathy.

Furthermore, the literature we have reviewed so far suggests both that each quadrant should have a unique neural signature as well as share some common neural circuitry. For example, medial prefrontal regions are likely to be implicated in propositional processing regardless of empathic focus. However, it is difficult to say at this point exactly what the neural signature of each quadrant may be because most studies have not explicitly isolated these elements.

Separating processes this way also suggests that behavioral responses in each quadrant may be moderated by unique variables. For instance, it seems likely that the extent to which other-focused experiential processing elicits an altruistic response depends upon the amount of personal experience that an individual has in the relevant domain. In contrast, the likelihood of altruistic behavior in response to other-focused propositional processing may relate to the prior knowledge that an individual has about the domain.

One recent study examined the relationship between experience and empathy by recruiting individuals with congenital insensitivity to pain (Danziger, Prkachin, & Willer, 2006). These individuals displayed semantic knowledge about pain that was very similar to controls, although their ratings of painful stimuli were lower and more variable. Interestingly, these judgments were highly related to individual differences in trait empathy, which was not the case for controls. It would be interesting to conduct a neuroimaging study to see if dissociable neural mechanisms are activated during the viewing of painful stimuli in others in controls and pain insensitive individuals. For example, would pain insensitive individuals activate dorsal anterior cingulate and anterior insula, or would they perhaps engage medial prefrontal regions to construct a more cognitive representation of the situation of the other?

The potential interrelationship of processing mode and empathy is nicely illustrated by the study of alexithymia. Alexithymia is characterized by difficulty in recognizing and describing one's own emotional states and has also been associated with difficulties in describing the emotional experience of others in hypothetical situations (Bydlowski et al., 2005). In a recent functional magnetic resonance imaging study, Moriguchi et al. (2006) found that alexithymics performed worse on theory of mind tasks and displayed reduced levels of empathy and higher levels of personal distress compared to controls. Furthermore, alexithymics showed lower levels of medial prefrontal activation during a theory of mind task. For all subjects, medial prefrontal cortex activity was positively correlated with mentalizing scores and negatively correlated with alexithymic symptoms. The authors interpret this finding as evidence that alexithymics have a mentalizing impairment that is associated with the inability to take the perspective of others. They further suggest that such a deficit might account for the inability of alexithymics to report upon their own feelings, as such a process might require the adoption of propositional processing towards the self.

Successfully adopting a propositional processing mode may also depend upon the inhibition of one's own experiential processing. Vogeley et al. (2001) found that a region of right inferior frontal cortex that is engaged when comparing conditions in which a participant attributes a mental state to a character in a story in which the participant is featured and one in which the participant is absent. In one recent intriguing paper, Samson and colleagues (Samson, Apperly, Kathirgamanathan, & Humphreys, 2005) extended this finding to describe an individual with a right inferior frontal gyrus lesion to see if this area is critical for the inhibition of self-perspective. Interestingly, this individual was impaired at theory of mind tasks that required the suppression of his own perspective but performed well if they did not. He also showed egocentric errors when performing social and visual perspective tasks. For example, in a visual array task, he consistently chose the array that corresponded to his own visual perspective. Interestingly, he seemed wholly unaware of his highly impaired performance and actually requested that the task be stopped because it was too easy. Future research in this area is needed to confirm the role of this region in the inhibition of self-perspective and also show its relationship to empathy. It would also be interesting to explore whether personality traits such as narcissism might be associated with abnormal function of this region.

Conclusion

The field of social cognitive neuroscience has recently turned its attention to the neural mechanisms that underpin the experience of empathy. This new area of research has already proven to be extremely fruitful in extending our understanding of how we represent the minds of others and share in their experiences.

We would like to conclude with some ideas for future research in this exciting new area. While pain has properties that make it an attractive stimulus with which to investigate empathy, it would be exciting to see future research expand methodologically to include more diverse forms of empathy. For example, there are virtually no neuroscientific studies of empathy for positive emotions, but there is no theoretical reason why sharing positive emotions is not as important to interpersonal functioning as sharing negative ones. One straightforward prediction would be to observe neural overlap between self and other for reward in the ventral striatum (Knutson & Cooper, 2005).

Additionally, because empathy is thought to be important partly due to its relationship to altruism and helping behaviors (Batson, 1991), studies of how neural processes relate to real-world behaviors would be extremely interesting. Phrased differently, to what extent can we predict everyday experiences of empathy as well as helping behaviors from the neural activation that we see in response to empathy tasks?

A productive line of research has already begun using imaging techniques to study how the neural responses of individuals who suffer from disorders such as autism differ from controls during empathic processes. Future research might use functional neuroimaging to investigate other disorders of empathy such as psychopathy. It is illuminating that psychopaths, who are by definition deficient in the experience of empathy, have been shown to exhibit normal theory of mind abilities but are impaired at recognizing emotions such as sadness and fear (Blair, Colledge, Murray, & Mitchell, 2001; Blair et al., 1996). It would be quite interesting to see, for example, whether psychopathic individuals show reduced activation of mirror neuron systems and whether such activations correlate with behavioral symptoms. This result would be convergent with findings in the autism literature, while a failure to find mirror neuron dysfunction would suggest that other neural regions are critically important in instantiating empathy.

Future studies might also investigate potential moderators of empathy and how the presence of such moderators affects neural responses. For example, if we are more prone to empathize with loved ones, the tendency to use strangers as targets may actually reduce our ability to detect an effect. Preston and de Waal (2002) suggest that similarity, familiarity, experience, and salience are important moderators of empathic experience, and these dimensions warrant further investigation. For example, behavioral responses akin to empathy in mice (as evidenced by social modulation of pain) only occur among mice who were familiar with each other (Langford et al., 2006). Motivation is also likely to be an important moderator of empathic responding. A suggestive recent study showed that mirror neuron activity related to grasping at food items was increased as a function of participant hunger (Cheng, Meltzoff, & Decety, 2007). More neuroscientific research that explores and is sensitive to the effects of these various moderators will greatly increase our understanding of empathy as a construct.

Furthermore, studying the moderators of empathy may give us more insight into situations in which we observe a failure of empathy. It is a sad truth about the human race that war, homelessness, violence, racism, and many other societal ills would be much less pervasive if we responded to all individuals in need with greater empathy. Therefore, research into how and why these failures occur may also be of critical importance in generating a more complete understanding of the phenomenon of interpersonal empathy.

It seems fitting to conclude by considering how this neuroscientific investigation may contribute to our social psychological understanding of empathy. Because this effort is in its infancy, it is still too soon to fully appreciate the contributions this research may make to psychological theory. Like many other psychological processes, empathy is difficult to introspect and report upon, and even gaining a sense of the component processes that make up empathic experience has proven challenging. The inability to know exactly what processes are taking place inside our minds when we experience empathy is probably one reason why there are so many different definitions of the phenomenon. However, this inherent difficulty is one reason why neuroimaging techniques have tremendous potential to help us gain a better understanding of the construct of empathy. For example, the current research suggests that both simulation theory and theory of mind play an important role in the experience of empathy. We have also reviewed evidence that these areas are subserved by different neural circuitry, which suggests that these processes may be qualitatively distinct but nonetheless interact. This literature further suggests that debates over which theory most correctly outlines how we understand the minds of others are perhaps somewhat misguided. It is probably more useful to consider the different component processes that are at work in the production of empathy, and neuroscience may help us to identify and understand these processes.

For example, as already reviewed, a very interesting question is whether personal experience in a domain is a critical moderator of the ability to empathize with another in that domain. Behavioral research is limited in its ability to address this question because it is difficult to assess the qualitative aspects of someone's empathic experience in this case. However, neuroimaging techniques might help elucidate questions like these, which are difficult to report upon through introspection. For example, if pain-insensitive participants show greatly enhanced prefrontal activity compared to controls, it might suggest that these individuals are understanding the target's pain in a more cognitive, propositional way than controls, which is likely to be a qualitatively different kind of empathic experience. On the other hand, if pain-insensitive participants engage the same neural regions as controls but show lowered levels of activation, it might suggest these participants share a qualitatively similar experience of empathy but the magnitude of this experience differs quantitatively. The first result would suggest that experience may determine the kind of empathy one feels, the latter suggests that experience is a critical moderator of our ability to empathize at all. These kinds of results would shed further light upon the component processes, moderators, and consequences of empathy, which would enrich our theoretical understanding of this psychological construct.

We hope that future research in this field will continue to attempt to elucidate unanswered social psychological questions about this fascinating, complex, and important topic.

Short Biography

Matthew Lieberman's primary research interests lie in the field of social cognitive neuroscience, which integrates concepts and methodologies from social psychology and cognitive neuroscience. He was recently honored with an APA early career award in recognition of his pioneering work in this field. Lieberman's previous publications include work on the neural bases of controlled and automatic processes, self-knowledge, interpersonal rejection, and cognitive dissonance. He is also the founding editor of the journal *Social Cognitive and Affective Neuroscience* (SCAN). Lieberman holds a BA in Philosophy and Psychology from Rutgers University and a PhD in Social Psychology from Harvard University. Currently, Lieberman is an Associate Professor in the Psychology Department at the University of California, Los Angeles. He is working on a book tentatively titled *Experience Shrugged: The Rise of Simulated Experience in Mental Life and the Modern World*.

Lian Rameson is currently a doctoral student and NSF fellow in the Social Psychology Department at the University of California, Los Angeles. Her interests include the neural correlates of self-knowledge and empathy. In collaboration with Matt Lieberman, she is currently conducting studies that examine the neural correlates of self-schemas and different forms of empathic processing. Rameson holds a BA in Psychology and English Literature from the University of California at Berkeley and an MA in Social Psychology from UCLA.

Endnotes

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