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A perception-action model for empathy

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You can only understand people if you feel them in yourself

John Steinbeck (1952/2002), *East of Eden*, p. 444

23.1 Introduction

This chapter describes and augments the perception-action model (PAM) of empathy, first detailed in Preston and de Waal (2002b). Empathy, ironically, is a term that means different things to different people. It has been difficult to distinguish empathy from sympathy because they both involve the emotional state of one related to the state of another. This problem was compounded by the fact that the mapping of the terms has recently reversed: what is now commonly called empathy was referred to before the middle of the twentieth century as sympathy (see Wispé, 1986 for a full discussion) and some researchers still use the old connotations (e.g. Batson, 1997).

According to a PAM, empathy is defined as a *shared emotional experience* occurring when one person (the subject) comes to feel a *similar emotion* to another (the object) as a result of *perceiving* the other's state. This process results from the fact that the subject's *representations* of the emotional state are *automatically* activated when the subject pays *attention* to the emotional state of the object. The *neural mechanism* assumes that brain areas have processing domains based on their cellular composition and connectivity; as such, there is no 'empathy area' and brain areas are recruited when the relevant domain is required by the task. This definition contains much information, so the model will be detailed in this chapter by deconstructing the definition, focusing on the italicized words.

23.2 Breaking down the PAM

23.2.1 Perception Action

This model is called the *perception-action model* because it is based on tenants of motor behaviour by the same name. In motor behaviour, the term *perception-action*

describes the fact that there are shared representations for perceiving and generating action. For example, if the subject witnesses the object swinging a hammer, then the part of the subject's brain that is used to swing a hammer is activated (e.g. the hand and arm region of the primary motor cortex). Naming and observing common tools activates the representation for the related motor act in the left premotor cortex (Grafton *et al.*, 1997) and even imagined movements activate the shared representations for perception and action (e.g. Jeannerod & Frak, 1999). In this way, the *perception* of *perception-action* in motor behaviour refers to direct perception as well as imagery or imagination and *action* refers to overt acts, imagined acts and even relatively abstract cognitive affordances.

A shared representation between perception and action was proposed in 1903 (Lipps, 1903), was emphasized in *Phenomenology of Perception* (Merleau-Ponty, 1962/1970), and defined the theories of Wolfgang Prinz (1992), Alan Allport (1987), and Michael Turvey (1992), but 1992 was a watershed year in the development of perception-action models. Searching for the keyword/term 'perception-action' in the database PsychInfo (November, 2004), there were 91 articles written on the topic between 1872 and 1992 (0.76 per year), 16 in 1992 alone (16 per year) and 408 since 1992 (34 per year). In 1992, some of the most important theoretical papers were published on the topic (e.g. Prinz, 1992) and the Rizzolatti group in Parma, Italy discovered 'mirror neurones' in the rostral-most part of the left premotor area that responded when a monkey observed and performed a grasping movement (di Pellegrino *et al.*, 1992). This latter finding made international headlines and, since then, neurones with similar properties have also been found in the rostral-most part of the right superior parietal lobule (Decety *et al.*, 1997; Iacoboni *et al.*, 1999).

As with motor behaviour, the stimuli for the PAM of empathy can be another person, animal, or even an entity such as 'the earth' or 'New York City', and the *perception* of the PAM can arise from situations where the subject directly perceives the object as well as situations where the subject imagines the state of the object (often called 'cognitive empathy', e.g. Povinelli *et al.*, 1992). Because the PAM is embedded in an evolutionary framework (Preston, 2004a; Preston & de Waal, 2002a, 2002b), we assume that the system evolved to handle live interactions with other individuals and so live objects drive the system better than imagined objects, resulting in more intense forms of empathy. In terms of the neural mechanism, this more cognitive form of empathy would probably not engage the amygdala, which usually responds to ephemeral stimuli requiring an immediate response, but would require the dorsolateral prefrontal cortex to maintain information about the object in working memory. In imagination, while additional activation is required to bring the state of the object into mind, once the subject succeeds in feeling the state of the object, the activation for the state would

be the same as that arrived at through direct perception. However, the strength of activation in imagined empathy is rarely as high as in direct empathy because of the increased difficulty in attending to internal over external stimuli.

23.2.2 Representations

The term *representation* has been used in psychology in many different contexts. In this case, a representation is a pattern of activation in the brain and body corresponding to a particular state so repeated instances of the same event reliably activate the same pattern. This is similar to a neural network (McClelland & Rumelhart, 1985), but here representation applies broadly to central and peripheral processes including autonomic arousal and endocrine responses – to all of the concomitants of the subject's subjective state. The term *representation* is used in this way to underscore that the brain and body give rise to complex emotion. For example, the temporal lobe is known to store long-term memories of people, places and objects, with the fusiform 'face' area specializing in face and eye-gaze information. The somatosensory-related areas store representations of feeling states with somatosensory cortex storing sensations and the cingulate cortex storing subjective reactions to the sensations. According to the PAM, these areas are necessary to the extent that the experience of the object involves these particular representations.

23.2.3 Shared emotional experience and similar emotion

Of course, a *shared emotional experience* is the sine qua non of empathy; by definition, empathy results when the subject feels the emotion of the object. In contrast to theories of empathy where the subject's state must match (e.g. Feshbach & Roe, 1968) or accurately portray (e.g. Levenson & Reuf, 1992) the state of the object, with the PAM the subject's state must be *similar to* that of the object. Accuracy and state matching are not discrete variables but rather exist in a continuum. It is improbable that the subject's and object's state will ever match exactly, and even if they did there would be no way to demonstrate it empirically. The PAM emphasizes degrees of matching between the subject and object because it relies on representations; the subject can only match or resonate with the state of the object to the degree that the subject has existing representations for the state of the object. This makes empathy itself a continuum.

Supporting the importance of similar representations in the PAM, empathy increases with past experience, similarity and familiarity. For example, subjects with highly distressing childhood experiences have more trait empathy and report more empathy for a patient in a video (Barnett & McCoy, 1989), presumably because they have ready access to representations of distress that are similar to those of the patient. Thus, the more similar the object's emotion is to something

the subject has experienced in the past, the more the subject's representations will match the object's and the more their states will resonate. Similar past experiences also make the subject more accurate, more helpful, and more likely to be characterized as empathizing. In contrast, less similar past experiences will make the subject less accurate, less helpful and more likely to be characterized as 'projecting' (putting his emotions onto the object). This feature of the model explains the layperson's definition of empathy whereby the subject can only say that they empathize with the object if they have actually had the same experience. For example, it is considered inappropriate, and sometimes even offensive, for a man to say that he empathizes with a woman's pain from childbirth or for a child to say that they empathize with the parent's distress from aging.

The role of representations can also eliminate the need to distinguish empathy from 'projection'. In empathy, the subject feels the object's state; in projection, the subject assumes his or her own state to be that of the object. Projection is thought to be inconsistent with empathy, because the mapping goes from subject to object rather than object to subject (Eisenberg & Strayer, 1987) and human interpretations of animal behaviour are often criticized for resulting from projection rather than perception (Mitchell *et al.*, 1997). With the PAM, the process is the same for both empathy and projection because in both cases the subject's representations are activated by perception of the object. Whether the subject is empathizing or projecting depends upon whether the subject's representations are similar enough to those of the object to convince the object that s/he is understood, or to convince observers that the object is understood. In a way there is no empathy that is *not* projection since the subject always uses his or her own representations to understand the object, but because of the intersubjectivity problem, this fact only becomes apparent when the subject says or does something inconsistent with the object's state.

Recognizing the overlap between empathy and projection, Hume noted 'a very remarkable inclination in human nature, to bestow on external objects the same emotions, which it observes in itself; and to find every where those ideas, which are most present to it' (1739–1740/1990; p. 224). A high-functioning autistic adult similarly believes that people do not think he can empathize simply because his way of experiencing the world differs from that of others and so his projections do not match their experiences and vice versa. He states, 'It is . . . much easier to empathize with someone whose ways of experiencing the world are similar to one's own than to understand someone whose perceptions are very different' (Cesaroni & Garber, 1991).

Hume also noted that it is easier to sympathize with someone if you have something in common with that person (1739–1740/1990). This refers not only to commonalities due to similar past experiences, but also to similarities due to

things such as personality, temperament and socioeconomic status because they predict overlap between the representations of the subject and object. In experiments with adult humans, subjects who witness the electric shock of an object offer to take the shocks for the object if their similarity is manipulated with demographic descriptions. If they do not feel similar, they only offer to take the shocks if they have to watch the object receive the remaining shocks (e.g. Batson *et al.*, 1981). In another paradigm, male subjects who were made to feel similar to an object who won money or was shocked showed more of a physiological response, identified with the object more, reported more distress to the shock and helped more (Krebs, 1975). Preadolescent boys imitate the actions of a model more in a war strategy game when manipulated to feel similar to the model (Rosekrans, 1967). In general, children prefer to play with children of the same age and sex (Smith, 1988) and have more empathy for objects that are the same sex (Feshbach & Roe, 1968). In our laboratory at the University of Iowa, subjects reported feeling the same emotion as they observed in an actor (but to a lesser degree), and the more similar they felt to the actors, the more intense ratings they gave of the actor's emotion (Preston *et al.*, 2003).

Familiarity with the object also increases empathy in the subject with the PAM for three main reasons, the first two being extensions of past experience and similarity. First, familiar individuals share past experiences, increasing the likelihood that they have representations in common. Second, people are usually closest to others of like age, gender, class and culture (e.g. Feshbach & Roe, 1968). Third, when the subject is familiar with the object, the subject has developed, over time, an internal model of the object. This model takes the form of a representation of the object in the subject, so when the subject perceives the object, this representation is activated, allowing the subject to be empathic even when the subject has not had a similar past experience. For example, a man may not share with his wife the fear of making a social blunder or the joy at fitting into a pair of jeans; however, because of their shared experience, the man can predict, understand and respond appropriately to his wife's state: he can be empathic.

Familiarity can even supplant absolute similarity, especially when emotional attachment is involved. In home tests of empathy with children, the family pet often responds with consolation to the adult feigning distress (Zahn-Waxler *et al.*, 1984). Lucy, a chimpanzee raised by a human family, is anecdotally described as exhibiting efforts to break up conflicts, running to comfort the wife when ill, exhibiting 'protectiveness toward her, bringing her food, sharing her own food, or ... attempting to comfort by stroking and grooming her' (Temerlin, 1975, p. 165). There are also anecdotal reports of apes helping unfamiliar birds and humans, sometimes even incurring great risk to do so (e.g. O'Connell, 1995). It is likely that the feeling of familiarity itself results from a facile mapping of object

onto subject, which can result from overt similarity (e.g. 'I felt like I have known him all my life') or from practice mapping the object onto the subject through shared experience. This explains how a subject that is dissimilar from the object can nonetheless identify with the object, such a human owner and its pet, a chimpanzee and its caretaker, or a babysitter with its baby charge.

23.2.4 Automatically

According to the PAM, when the subject attends to the state of the object, the relevant representations will automatically activate. As an example, if the object displays a facial expression or a body posture indicating sadness, the areas in the subject's brain that represent those movements and that feeling are automatically activated. This fact about emotion perception is most noticeable when the object's state is particularly salient to the subject, such as the jerking of a leg in a soccer fan before the big kick or the drawn facial expressions of movie-goers in an intense moment. In these cases, a brief, truncated version of the movement is produced – an 'ideo-motor action' (c.f. Carpenter, 1874; Prinz, 1987). These 'leaks' occur when the subject is particularly engrossed in the state of the object, attending to the state of the object and not attempting to control his or her reaction.

This phenomenon is the result of processes in the cerebellum and the frontal lobes. The frontal lobe normally inhibits behaviour centrally while the cerebellum inhibits behaviour peripherally (through projections to the pons where it inhibits motor neurones descending to the dorsal root ganglion). But in 'feed-forward models' (Wolpert *et al.*, 1998), projections from the cerebellum determine if the subject's actions are executed as planned; if the expected response is not detected, an error signal is generated that reduces inhibitory processes in the frontal lobes and spinal cord. In *the subject*, this is probably adaptive because the reduced inhibition facilitates the expected action, but if the subject is instead modelling the state of *the object*, then reduced inhibition would cause the subject to enact the expected behaviour of *the object*, thus accounting for ideomotor actions. For example, if a soccer fan watches a wing run down the field toward the goal and stop, the expected action is to kick the ball toward the goal. If this action is not taken by the object, an error signal is generated in the subject, reducing motor inhibition and resulting in an actual kicking movement in the subject. Such reduced inhibition also explains large, non-functional acts that are generated when a subject is surprised, such as arms flailing and shouting.

As with the PAM itself, these concepts from motor behaviour can be applied to explain phenomena in empathy. During *direct* forms of empathy, the forward model generates in the subject a prediction regarding the affect of the object, which can out as a contagious display when inhibition is reduced. During *indirect* forms of empathy, the forward model generates a sensation for how the object must feel,

even though the object is not present, and uses this information to respond appropriately. In this cognitive form of empathy, subjects could take the spatial perspective of the object (as proposed by perspective-taking models of empathy, e.g. Decety & Chaminade, 2003), but more often subjects probably just imagine themselves to be the object. In this process, the orbitofrontal cortex is needed as a 'convergence/divergence zone', to link the constructed feeling state of the object with an appropriate response (Bechara *et al.*, 2000). Disorders of empathy and functional imaging studies of empathy (discussed below) support this proposed role for the cerebellum and frontal lobes in empathy.

23.2.5 Attention

Even though activation of the subject's representations is automatic, this does not mean that one should expect to see contagious behaviour whenever a subject perceives an object. Subjects' responses are not predetermined, unavoidable, or beyond the ken of conscious will, primarily because the subject must *attend to* the state of the object; oftentimes the subject does not attend to the object fully. Because of the PAM, it is inherently distressing to attend to the distress of another, so subjects allocate attention to control the extent to which they are drawn into the object's situation. For example, people turn their heads away from the homeless man and change the channel in response to a plea for aid for impoverished children. However, even when the subject attempts to look away from the object to control his or her reaction, a covert response may still occur. For example, in orienting studies with infants, even though overt distress can be decreased by distracting the baby, distress returns to almost equal levels when the distraction is removed, and the hormonal stress response remains throughout (reviewed in Rothbart *et al.*, 1994). This internal 'distress keeper' may be the mechanism for negative feelings such as guilt and remorse that pervade even when attention is shifted. As evidence, trait sympathy is correlated with the probability for entering situations of distress and the susceptibility for guilt and shame after refusing to help (reviewed by Smith, 1992).

The cerebellum (and its interconnections with the frontal lobe) is necessary to learn and execute such attentional shifts, to track the state of the object, and to avoid attending to the object when doing so would be unnecessarily distressing. This structure is probably more necessary for more subtle events (e.g. the object darts his eyes at the mention of a sensitive topic), which require attention, tracking and processing speed involving connections between the cerebellum and the frontal eye fields; larger displays (e.g. crying and smiling) can be understood explicitly.

Despite attention, an automatic response may not be observable; the subject might not even feel it. There are degrees of emotion in the object, degrees of

attention to the object and, thus, degrees of activation. Thus, the activation of the relevant representations in the subject may not be strong enough to reach the threshold for generating a response or for reaching conscious awareness. Mere comprehension of the object's state by the subject is evidence that the relevant representations were activated to a degree; this can be demonstrated with functional magnetic or PET imaging (see studies below), with EEG, MEG or TMS, and with behavioural paradigms that use reaction time. For example, in our own laboratory we have shown that people automatically process the emotion in faces (using Ekman's face stimuli), even when they are attending and responding to superimposed words. Subjects also may not exhibit a matching response to the object because of mechanisms to inhibit such responses (discussed above). The fact that these inhibitory processes develop over the course of a lifetime explains the developmental sequence of empathy from emotional contagion to mixtures of contagion and helping to 'true empathy' (Ungerer, 1990). For example, infants' attention towards and imitation of a model decreases between 2 and 6 months (Field *et al.*, 1986).

A benefit of the PAM is that it can predict when a subject will attend to the object. Subjects will attend more to salient stimuli such as loud displays of distress and releasing stimuli such as crying (Colby & Goldberg, 1999; Taylor & Stein, 1999). In my ongoing investigation into subjects' responses to the distress of patients with chronic or terminal illness, subjects' responses bifurcate at the highest levels of distress. Half of the subjects report empathy levels that increase linearly with the level of distress of the patient, while the other half report empathy levels that drop off at the highest levels of distress (Preston, 2004b). The latter subjects may decrease responding because they are overwhelmed and thus divert attention away from the films or because they perceive the patient's display of distress to be disproportional to the need (i.e. 'neediness'). Subjects tend to offer more help when the level of need or potential benefit to the object is higher (e.g. Staub & Baer, 1974), so they may not feel empathic towards objects who do not appear to have a legitimate need. A current fMRI study is investigating this further.

Because of the shared representations of perception and action in the PAM, subjects are predicted to attend to objects that require a response. In group-living species, objects who require a response are those that the subject relies upon to attain personal goals, usually friends and relatives. This interdependence can be temporary and superficial, like when the subject and object must cooperate for a local goal or when the object's distress blocks a goal of the subject. For example, human children are more motivated to help when they have a responsibility for the object's distress (Chapman *et al.*, 1987) and monkeys that are trained to cooperate for food dramatically increase conciliation (Cords & Thurnheer, 1993). Interdependence can also be long lasting and deep, for example

the interdependence of family members or spouses who must cooperate for long-term goals spanning a lifetime. For example, species with cooperative kin relationships show higher levels of reconciliation between related individuals than non-related individuals (e.g. Aureli *et al.*, 1992) and in chimpanzees, where male alliances are very important, reconciliation is higher among males than among females (e.g. de Waal, 1986). In general, the more interdependent the subject and object, the more the subject will attend to the object, the more their similar representations will be activated, and the more likely a response.

Once the subject attends to the state of the object, emotion-perception areas such as the limbic system will be activated. The amygdala projects directly to brainstem areas that control autonomic states and code for learned emotional associations, and projects indirectly to hypothalamic nuclei that control endocrine responses and maintain homeostasis. The limbic circuit also projects to the cingulate cortex, which stores representations of affective states, and to the orbitofrontal cortex, which helps regulate emotion (preventing overarousal), links the event to stored representations in long-term memory and generates an adaptive response (Bechara *et al.*, 1994).

Most of the examples in this chapter are for negative emotional states such as distress, and indeed distress is the typical emotion of the object when the term empathy is used colloquially or in the literature. However, the model also applies to positive emotions and is likely to be particularly apparent in emotions such as joy and excitement. It is often postulated that negative emotions are more biologically relevant because they are more crucial for survival (e.g. Adolphs *et al.*, 1995; Ekman *et al.*, 1983), as in the proverbial case of the man running from the tiger in the savannah. This is unlikely to be the case since positive reward states associated with eating, mating and care of offspring are at least as important for survival as the fear of predators. However, these positive states are usually classified as drive states or motivations rather than emotions and so have not entered the dialogue into positive emotions although they surely qualify. Another possible reason why the literature focuses on negative states is that neuroscientific research often studies animals and it is considered more difficult to research the origins of positive emotions in animals. However, this is probably only true for more abstract positive emotions (which are also difficult to study in humans) and positive emotions such as excitement are palpable in many animal displays, for example the pacing of rats before a food reward or the jumping of sled dogs before a race. According to the PAM, negative states are not actually more entrenched or easy to study, but they are more salient to researchers because they require a response. Distress requires alleviation and psychological disorders require a cure, but joy is a state for which we should just be grateful. Cross-cultural research is needed to determine whether our focus on eliminating negative states rather than preventing

them or striving for positive states is a product of the nervous system or is just a characteristic of Western culture.

23.3 Recent neuroscientific evidence

Recent imaging research supports the PAM because evidence supports the existence of shared representations for perception and production of emotional states and the exact structures engaged depend on the type of task. Tasks where the subjects must observe the emotional state of the object such as pictures of basic emotions (Carr *et al.*, 2003), videos of actors telling sad stories (Decety & Chaminade, 2003), visual cues that a loved one is in pain (Singer *et al.*, 2004), videos of objects displaying disgust (Wicker *et al.*, 2003a) and pictures of an object's bodily state of fear (de Gelder *et al.*, 2004) engage areas known to be related to the representation of one's own feeling state such as the anterior insula and cingulate cortex. Supporting the PAM, experiencing pain and being cued that another is experiencing pain both activate the anterior insula, rostral anterior cingulate, brainstem and cerebellum, and the activation in the insula and cingulate correlates with trait empathy. When subjects view static pictures of body postures during neutral gestures versus gestures of fear and happiness, the emotion-representation areas are activated (orbitofrontal cortex, posterior cingulate, anterior insula, nucleus accumbens, amygdala) as well as areas that represent action [inferior frontal gyrus, the supplementary motor area (SMA), inferior parietal lobule, precentral gyrus] (de Gelder *et al.*, 2004). The authors interpreted the motor activation as evidence for response preparation to a fearful stimulus, but more research is required to separate matching or imitative activation of the object from activation related to the subject's response. For example, the activation in this study was in pre-SMA and previous research found anterior SMA activity to be associated with grasp observation and imitation and posterior SMA activity with grasp performance (Grafton *et al.*, 1996a). Tasks where the subject must take the perspective of the object have found consistent engagement of right inferior parietal (thought to suppress the subject's own perspective) and medial prefrontal and frontal pole (thought to inhibit the subject's self-processes) (Decety & Chaminade, 2003; Decety *et al.*, 2002; Ruby & Decety, 2001). In a task where objects directed their emotion toward the subject (as opposed to away from the subject), the anterior portion of the superior temporal lobe was selectively activated (Wicker *et al.*, 2003b). Observation of an object being touched activates the secondary sensory area (SII), the brain area that represents the sensation of touch (Keysers *et al.*, 2004).

In our own investigation of cognitive empathy (Preston *et al.*, 2002), subjects imagined events of fear or anger either from their own past or from the past of

another subject (to which they could relate or not). There were no differences in activation or arousal between personal and empathic imagery when the subject *could* relate to the situation of the object, presumably because subjects simply activated their own existing representations. However, when the subject *could not* relate to the situation of the object, there was less autonomic arousal and more neural activation in the left fusiform gyrus and the left cerebellum, presumably because they did not have a similar representation and had to create an image online by activating high-level visual association cortex and posterio-lateral cerebellum, which is more associated with imagined movement (though usually on the right; Allen *et al*., 1997; Grafton *et al*., 1996b; Hanakawa *et al*., 2003). This same portion of the cerebellum was activated in the Singer *et al*. study (2004) both when subjects experienced pain and were cued to the pain of a loved one. Taken together, the results support the idea that empathy is a distributed process that recruits different brain structures depending on the nature of the task, rather than localized to a single location in the brain, such as the right prefrontal cortex (c.f., Gallup & Platek, 2002).

Not all brain areas are in common between perception and action or between perception and imagination. For example, performing, imagining and observing a grasping movement all activate SMA, but performing activates the caudal portion of SMA-proper while imagining (and to a lesser extent, observing) activates the rostral portion of SMA-proper. The anterior cerebellar cortex is active for performing, while different portions of the right posterior cerebellum are active for imagining and observing. Effects are often seen in hemispheric differences, such as the activation of dorsal premotor cortex on the right for observation and the left for imagination (Grafton *et al*., 1996a). Similarly, experiencing pain and imagining the pain of another both activate areas that represent the affective quality of the pain stimulus such as the *anterior* insular cortex and the *rostral* anterior cingulate cortex. In contrast, only experiencing pain directly activated the areas that represent the sensory quality of the pain stimulus such as the *posterior* insula, *caudal* anterior cingulate cortex, SII and SI (Singer *et al*., 2004). These shifts in location within a brain area or non-overlapping activations between perception and action are to be expected because, after all, different qualitative experiences cannot occur without some different biological substrates, but the PAM is bolstered by findings of overlap in the representations.

23.4 Disorders of empathy

Empathy disorders are characterized by impairments in the conception of mental states, expression of emotions and verbalization of feeling states due to dysfunction in the brain areas that subserve empathy (c.f., Baron-Cohen, 1993). Because

the PAM characterizes empathy as a process with multiple necessary phases, it can account for disorders of empathy that have different aetiologies. In order to achieve empathy, subjects must be motivated to and capable of attending to the state of the object, they must be able to activate personal representations of a similar state, and to generate an emotional response. Thus impairment in any of these phases will create an impairment of empathy.

23.4.1 Autism

Individuals with autism show impairments in expression, imitation and recognition of expressions and gestures, making it likely that autism is characterized by an impairment early on in the perception-action pathway, such as in attending to the relevant stimuli in order to perceive and learn from the emotional states of others (see also Williams *et al.*, 2001). There is also evidence for impairment in autism in multiple brain areas including the frontal lobe, amygdala and cerebellum (Harris *et al.*, 1999).

23.4.2 Psychopathy

Individuals with psychopathy do not generate appropriate psychophysiological responses to emotional stimuli (Blair, 1999; Blair *et al.*, 1997). Thus, in the context of the PAM, these people have an impairment of empathy because they cannot link the distress of the object to their own feeling states. There is reduced prefrontal grey matter in men with psychopathy compared to multiple control groups and the individuals with smaller volumes also have reduced skin conductance responses on a social stressor (Raine *et al.*, 2000). Individuals with psychopathy also have abnormalities in the corpus callosum (Raine *et al.*, 2003), amygdala (Blair & Frith, 2000), anterior temporal lobe and lateral frontal lobe, and in functional imaging studies, there are differences in activation in multiple brain areas suggesting that psychopaths process emotional as well as non-emotional stimuli differently than controls (Kiehl, 2000; Kiehl *et al.*, 2004).

23.4.3 Frontal lobe damage

The frontal lobes are often implicated in disorders of empathy for multiple reasons. Theoretically, the frontal lobes are thought necessary to focus on the state of the object, to link the object's state to the subject's own feeling states and memories, and to inhibit contagious and imitative responses. There are documented impairments in empathy in subjects with acquired damage to the frontal lobes (Eslinger, 1998) and individuals with early, developmental damage to the frontal lobe have a syndrome that presents similarly to psychopathy with decision-making problems and emotional insensitivity (Anderson *et al.*, 1999). Empathy impairments in sociopathy as well as autism are thought to be partially due to a

disruption in the prefrontal system because both disorders have abnormalities in the frontal lobes (above) and involve deficiencies in planning, attention and inhibition (e.g. Gillberg, 1999). Even if frontal patients may imitate the object's actions (Lhermitte *et al.*, 1986) they cannot share in the state of the object because they can no longer link the state of the object to the representations of feelings and, thus, cannot experience empathy.

The fact that the frontal lobes are necessary for empathy does not mean that it is a putative 'empathy area' since many other areas are activated in functional imaging studies of empathy and are damaged in disorders of empathy (e.g. cerebellum). Moreover, the effect of brain abnormalities on empathy depends on an interaction between location and the time of damage. For example, early damage to the amygdala would preclude the development of appropriate emotional responses while late damage to the amygdala would prevent new emotional experiences from being processed, but would leave cortical representations intact and accessible through frontal connections (e.g. LeDoux, 1996/1998).

23.4.4 Depression

The PAM predicts that individuals with depression would have an empathy impairment due to an excessive focus on the self, precluding the necessary interest in and attention to the state of the object. There seems to be a paucity of research on this topic – the majority of research is aimed at using empathy to *help* individuals with depression, or looks at effects of maternal depression on empathy in offspring. An inverse relationship between empathy and depression has been supported (Andersen, 2001), but surprisingly, multiple investigations have also found positive relationships between empathy and depression (Forgus, 1995; Gawronski & Privette, 1997; Horne, 1999; McLaughlin, 1996; O'Connor *et al.*, 2002; Zahn-Waxler *et al.*, 1991). Discrepancies are both theoretical and definitional. Theoretically, empathy and depression may be inversely correlated within an individual, but it is thought that some exposure to maternal depression may sensitize children to the emotions of others, making them more empathic (but see Jones *et al.*, 2000). Effects also depend on the type of depression and the type of empathy because while major depression may decrease the likelihood of empathy, it increases the likelihood of empathic distress (O'Connor *et al.*, 2002). Cognitive empathy decreases the chances of reactive depression in caregivers while emotional empathy increases the chances (Gawronski & Privette, 1997). Faced with a depressed parent, children who were actively empathic were less depressed while those who were emotionally overinvolved were more depressed (Solantaus-Simula *et al.*, 2002).

The different relationships found in these studies point to the importance of a non-linear relationship between arousal and empathy, with the highest levels of

empathy occurring at intermediate levels of arousal. Eisenberg and colleagues have repeatedly found that empathy is best predicted by the combination of high emotionality and high emotional regulation because subjects without the ability to regulate emotion tend to become personally distressed and thus self-focused in the face of the object's distress (Eisenberg *et al.*, 1998).

23.5 Summary

The perception-action model of empathy was originally based on the shared representations of perception and action in motor behaviour, because such shared representations could easily explain how a subject could come to feel the emotional state of an object. Much behavioural evidence in empathy, in humans and animals, points to the fact that subjects use their own representations in order to understand and feel the state of the object, such as increases in empathy with shared past experiences, similarity and familiarity. Since the model was conceived, additional neuroscientific evidence for the PAM has emerged, demonstrating that the neural substrates for experiencing an emotion overlap with the substrates for perceiving that emotion. Evidence from neuroscience as well as from disorders of empathy support the PAM because appropriate empathic responding requires a distributed neural circuit that allows for all phases of the empathic process. The subject must be able to attend to the object, experience a similar emotional state as the object, and respond appropriately to the object all while inhibiting contagious distress and maintaining focus on the object. If the integrity of any of these processes is undermined, so is the subject's ability to empathize.

There are still many things to discover about empathy. For example, it is currently unknown if there are qualitative differences between empathy for positive and negative states or between empathizing in order to help a loved one versus hurt an enemy. We also need to distinguish among the various models and types of empathy such as between descriptions where the subject imagines he or she *is* the object versus imagines what it would be like to *be* the object. The neurosciences also need to make tests of shared-representation theories more falsifiable and to contrast among empathic states rather than between empathic and neutral states. Tools with good temporal resolution (EEG, MEG, event-related fMRI) should also be used to look at changes over the time-course of the empathic process. For example, the initial process of effortfully trying to empathize can be compared with the subsequent feeling of empathy or the initial process of resonating *with* the object can be compared with the subsequent response *to* the object. There is much work to be done, but by employing strong inference to resolve specific questions in the literature, agreement can be reached.

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