

# CHAPTER 2

## You, Me, and My Brain: Self and Other Representations in Social Cognitive Neuroscience

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“Say this blanket represents all the matter and energy in the universe, okay? This is me, this is you. And over here, this is the Eiffel Tower, right, it’s Paris!”

—Bernard Jaffe, *I Heart Huckabees*

In the film “I Heart Huckabees,” the magic of digital effects allows characters to see bits of themselves appear in the pixilated faces of others. Soon after experiencing this literal mirroring of him- or herself in someone else, each character is moved to act compassionately, even toward previous enemies. Vaguely echoing Eastern philosophy, one of the main characters (as quoted above) claims that in moments of clarity, people come to understand that they are actually made from the same blanket, so to speak, and that self/other distinctions are an illusion.

Does dissolving boundaries between ourselves and others actually help us to navigate the social world? Do we, in fact, understand the mental and emotional states of others using processes that are similar to those we use to think about ourselves? As with most psychological questions this broad, the answer is most likely both yes and no. On the one hand, behavioral research suggests that quite often we use ourselves as a template or anchor when trying to piece together the contents of someone else’s mind. This overlap is attested to by our astonishing success at quickly inferring and learning from the goals of others, a type of learning that would only be possible if we understood

others as operating much like we do, in pursuit of goals much like our own (Tomasello, 2000). These tendencies produce predictable errors as well. For example, before their 4<sup>th</sup> birthday, the majority of children despotically assume that others see the world the way they do, and it takes the development of inhibitory control to quell this tendency and enable children to understand that others have thoughts and desires independent from their own (Carlson & Moses, 2001). Similarly, adults will incorrectly guess that things they have just learned (e.g., the brand names of two sodas in a taste test) will be known by others who have not had the benefit of having the answers told to them, and it takes cognitive effort to override this assumed overlap and correctly judge other people’s state of knowledge (Epley, Keysar, Van Boven, & Gilovich, 2004).

On the other hand, most adults are easily able to gauge the difference between their own mental states and those of others, and we do so countless times every day. Planning surprise birthday parties and imagining what Christopher Columbus would think about a Corvette are just two examples of situations in which perceivers are able to separate their minds from those of others and use rule-based processing to infer the contents of those others’ mental states.

How do we reconcile our tendencies to think of others as being similar to us with the importance and ease of seeing ourselves as different

from others? To address this issue, this chapter adopts a social cognitive neuroscience (SCN) approach, using information about the brain to constrain thinking about the psychological processes involved in perceiving people. We review neuroimaging research on self-perception, emotion, and social cognition with an eye toward understanding the person perception processes that lead to our dual tendencies to see others as both like and not like ourselves. Our framework differentiates between two modes of processing information about people—one that is a quick, direct, and bottom-up and another that is deliberative, reflective, and top-down. We then examine whether self and other overlap may depend critically on which mode of processing perceivers are engaging.

Toward this end, the remainder of the chapter is divided into three parts. First, we describe elements of the SCN approach that guide the formulation of our framework. Then, in the second and most detailed section of the paper, we review and synthesize recent imaging research on self and other perception in both direct and reflective modes of processing. This section unpacks each cell of the 2\*2 matrix created by crossing the target being perceived (self or other) with the mode of processing used to perceive that target (direct or reflective). For each cell, we draw on a growing neuroimaging literature to help constrain our thinking about the information processing steps that characterize self-perception and other perception. By qualitatively examining commonalities and differences among activation foci from previous studies on self-perception, emotion, and social cognition, we can identify neural systems engaged by each processing mode and for each type of social perceptual target. Finally, in the third section, we use prosocial behavior as an example of how knowledge about neural representations of self and other can help inform our understanding of long-standing social psychological questions.

## **A SOCIAL COGNITIVE NEUROSCIENCE APPROACH**

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Social cognitive neuroscience emerged in the past decade as a combination of the theories

and methods of its parent disciplines: social psychology and cognitive neuroscience (Ochsner, 2007; Ochsner & Lieberman, 2001). True to its heritage, SCN's goal is to understand the abilities necessary to effectively navigate the social world at multiple levels of analysis, bridging descriptions of social and emotional behaviors and experiences to models of their underlying psychological processes and neural bases.

SCN differs from its parent disciplines in a few important ways. Most obviously, SCN differs from its social psychological parent in its use of neuroscience data to constrain and inform psychological theory (Lieberman, 2007). But there is another important, and perhaps less obvious, way in which SCN is distinguished from the other of its parents. In contrast to much—but not all—of cognitive neuroscience research, SCN emphasizes the core social psychological idea that situations or contexts determine how we think and act (Ochsner, 2007). So central is this idea to social psychology that, as Matthew Lieberman put it, "...if a social psychologist was going to be marooned on a deserted island and could only take one principle of social psychology with him it would undoubtedly be the 'power of the situation'" (Lieberman, 2005). The same might be said of the social cognitive neuroscientist.

Previously, we have argued that the goal of SCN is to construct multilevel models of the way in which one's current context—which includes both the external situation and one's internal states and traits—constrains how we construe the meaning of social cues (Ochsner, 2007). Whereas the cognitive neuroscientist might want to understand the brain systems involved in perceiving faces or facial expressions of emotion, a social cognitive neuroscientist might want to take that understanding further by asking how one's interaction goals (e.g., to form an impression or to connect empathically), beliefs about the other person's intentions (e.g., whether they intend to help or to deceive), or similarity between themselves and a target (e.g., ethnically or politically) shape the cognitive processes and neural systems engaged by perceiving that same emotional expression.

In the sections that follow, the SCN approach will guide a systematic review of recent

**Table 2-1 Person Perception Phenomena Included in Meta-Analysis Grouped as a Function of Mode of Processing and Target of Processing**

		Target	
		Self	Other
Mode of processing	Reflected	Traits, emotion, preferences	Traits, emotion, beliefs, knowledge, familiarity, intentions
	Direct	Pain, arousal, emotion, agency	Traits (stereotypes), intentions, goal-oriented movement, emotion

functional imaging research exploring distinctions in the neural activation corresponding to distinctions between targets (self or other) and modes of processing (direct or reflected). Tables 2-1 and 2-2 indicate the phenomena and studies that were included in each cell of this 2\*2 matrix.

Neuroimaging data can help constrain our theories about how these processes interact in two ways: first, by showing that two or more types of behavior that could be viewed as similar—such as explicit and implicit memory formation, actually depend on different information processing mechanisms; (Schacter, Alpert, Savage, Rauch, & Albert, 1996) and, second, by showing that two types of behavior that were thought to be different, such as visual perception and visual imagery, actually depend on similar mechanisms (Kosslyn & Ochsner, 1994; Kosslyn, Thompson, & Alpert, 1997). Furthermore, aggregating results of several studies allows for examining the reliability of relevant findings, such as the activation of a certain brain region during a certain task type (cf. Phan, Wager, Taylor, & Liberzon, 2002).

With this in mind, the review below describes how different systems of brain regions come into play as a function of situational (i.e., context-specific) goals to understand thoughts, emotions, or traits, goals that in turn lead one to engage in direct or reflective modes when perceiving different kinds of social targets (i.e., one's self or other people).

## FROM DATA TO THEORY: BUILDING A SOCIAL COGNITIVE NEUROSCIENCE FRAMEWORK FOR UNDERSTANDING SELF-OTHER REPRESENTATION

If Bernard Jaffe's notion that all people are cut from the same fabric is to be treated as more than a post-hippie platitude, it needs to be grounded in empirical research findings. The goal of this section is to use a review of brain imaging data to bring ideas about self-other similarity down to the brain. To accomplish this goal, we first briefly review past SCN work that has attempted to identify the neural correlates of direct and reflective modes of processing information about the self and about others. This work sets the stage for our review of neural systems implicated in direct and reflective modes of processing for self and other.

### Dual-process models in Social Cognitive Neuroscience

Explanations of behavior that appeal to the interplay between direct or automatic processing on the one hand, and reflective or controlled processes on the other are about as old as experimental psychology itself. In social psychology, many such dual-process models have been offered to explain person perception phenomena ranging from stereotyping and dispositional inference to emotion regulation (Gilbert, 1999; K. N. Ochsner & Gross, 2004).

Although the details vary from theory to theory, most models agree upon the basic properties of a direct and automatic mode of processing as opposed to a controlled and reflective one (for several examples of such theories, see Chaiken & Trope, 1999). Automatic processes are thought to operate without the costly and cumbersome need to bring mental contents into our awareness for deliberation. Through the simple perception of stimuli that activate mental representations of emotions, stereotyped out-groups, our self-concept, and so on, automatic processes can guide the formation of impressions, can shape judgments and decisions, can generate emotions, and may even queue up goals that motivate and guide actions (e.g. Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trotschel, 2001). By contrast,

**Table 2–2 Studies Included in Meta-Analysis as a Function of Mode of Processing and Target of Processing**

		Target			
		Self	Other		
		Author/year	Phenomenon	Author/Year	Phenomenon
Mode of processing	Reflected	Fossati 03	Trait Attribution	Brunet 00	Intentions
		Moran 06	Trait Attribution	Calarge 03	Mental States
		Hutcherson 05	Emotion	Castelli 00	Intentions
		Kircher 05	Trait Attribution	Gallagher 00	Beliefs
		Kjaer 02	Trait Attribution	Goel 95	Knowledge
		Lou 04	Trait Recall	Moran 06	Trait Attribution
		Ochsner 04	Emotion	Hynes 06	Mental States, Emotion
		Ochsner 05	Trait Attribution	Lou 04	Trait Attribution
		Ruby 01	Intentions	Mitchell 04	Impression Formation
		Schmitz 04	Trait Attribution	Mitchell 05a	Impression Formation
	Seger 04	Preference	Mitchell 05b	Mental States	
	Phan 04	Emotion	Mitchell 05c	Mental States	
	Kelley 02	Trait Attribution	Mitchell 06	Impression Formation	
			Ochsner 04	Emotion	
			Ruby 01	Intentions	
			Saxe 03	Beliefs	
			Schmitz 04	Trait Attribution	
			Seger 04	Preferences	
			Vollm 06	Mental States, Emotion	
		Direct	Aalto 05	Emotion	Botvinick 05
	Botvinick 05		Pain	Carr 03	Emotion
	Cato 04		Emotion	Chaminade 02	Intention
	Farrer 02		Intention	Decety 02	Intention
	Hutcherson 05		Emotion	Decety 03	Emotion
	Morrison 04		Pain	Farrow 01	Emotion
	Paradiso 99		Emotion	Jackson 05	Pain
	Schaefer 05		Emotion	Jackson 06	Pain
	Singer 04		Pain	Morrison 04	Pain
	Sugiura 00		Self Recognition	Ramnani 04	Agency
	Taylor 03	Emotion	Saarela 06	Pain	
			Singer 04	Pain	
			Winston 03	Emotion	
			Hooker 03	Intention/movement	
			Pelphrey 04	Intention/movement	

controlled processes are recruited when, for whatever reason, we need to reflect on or control the impressions, feelings, thoughts, or actions generated by processes operating automatically outside our awareness. Typically reflective control occurs either because we have the explicit goal to be deliberative in a given situation or because of some error or problem produced by

the direct mode of processing. Depending on the theory, these two types of processes have been described as working either in competition or in collaboration, either simultaneously or exclusive of one other, and with or without sharing information (Gilbert, 1999).

Recently, dual-process models have begun to inform SCN analyses of person perception

(Keysers & Gazzola, 2007; Lieberman, 2007, in press; Zaki & Ochsner, 2009), emotion (Ochsner & Feldman Barrett, 2001), and emotion regulation (Ochsner & Gross, 2005). In general, these models posit that the direct and bottom-up route for perceiving people or generating emotion depends on brain systems different from, but partially overlapping with, those involved in the reflective mode of processing. Although the neural players implicated in the direct mode may vary from context to context, depending on the specific features of the stimulus at hand (e.g., whether it is painful, visual, auditory, verbal, or pictorial, and so on), for reflective control one player takes center stage for virtually all behaviors. The prefrontal cortex (PFC) is thought to be essential for most aspects of reflective processing, and current work is examining the role of discrete frontal regions in holding information in memory, selective attention, inhibiting prepotent impulses, and higher-order reasoning.

### Self and Other Perception in Social Cognitive Neuroscience

As discussed above, questions about whether we see others as we see ourselves have been central to behavioral research for many years. SCN work begun to investigate this issue by asking a related question: whether judgments about one's own states and traits depend on brain systems similar to judging the states and traits of others. This question has been asked in parallel by two different literatures in the field. The first has to do with the neural overlap underlying *conceptual* representations of the self and others and has most often been associated with research on theory of mind. One region in particular—the medial prefrontal cortex (mPFC)—consistently plays a key role in judgments about both self and other, but the nature of mPFC's involvement it is not yet clear. Some studies have found greater activity in ventral portions of mPFC when thinking about one's own as compared to a non-close other's traits (Fossati et al., 2003; Kelley et al., 2002; Macrae, Moran, Heatherton, Banfield, & Kelley, 2004; Northoff et al., 2006). Studies of theory of mind and perspective taking have found activations in

more dorsal areas of mPFC occurring while subjects make judgments about the mental states of others (Fletcher et al., 1995; Gallagher et al., 2000; Goel, Grafman, Sadato, & Hallett, 1995; Mitchell, Heatherton, & Macrae, 2002). Other work suggests that the mPFC regions involved in making judgments about one's self and someone else's mental state may overlap (K. N. Ochsner et al., 2005) and that furthermore, this overlap may be moderated by how similar perceivers feel to the people they make judgments about (Mitchell, Banaji, & Macrae, 2005; Mitchell, Macrae, & Banaji, 2006).

The second literature concerns the overlap between the brain areas underlying *motor* representations of self and other and has been centered in research on so-called “mirror neurons” in the premotor cortex of nonhuman primates. These neurons fire both when primates perform an action and when they see another animal performing the same action (Rizzolatti, Fogassi, & Gallese, 2001). This overlap in neural action representations has been reproduced in humans, and a growing number of studies have explored overlapping representations of sensory experiences as well. For example, one fMRI study exposed unlucky participants to aversive odors as well as faces expressing disgust and showed an overlap in activation of the insula for both of these conditions (Wicker et al., 2003). Similar studies have shown overlaps in the perception of pain (Botvinick et al., 2005; Jackson, Meltzoff, & Decety, 2005; Morrison, Lloyd, di Pellegrino, & Roberts, 2004; Singer et al., 2004), touch (Keysers et al., 2004), and basic emotions (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Leslie, Johnson-Frey, & Grafton, 2004).

“Motor theories” of social cognition and empathy, largely based on the mirror neuron literature, suggest that social cognitive abilities are mediated largely by the fast, automatic, and bottom-up activation of representations of internal states that perceivers see in others. These representations are overlapping, or “shared,” to the extent that they are recruited both when one engages in an action and when one sees someone else engaging in the same action. An assumption made by these motor

theories is that the bottom-up or stimulus-driven activation of “shared” affective representations creates the feeling in a perceiver that he or she would experience if an event being witnessed was experienced personally. For example, seeing someone else get kicked in the shins may cause a perceiver to wince automatically, actually feeling some measure of discomfort themselves. Motor theories take this and other similar phenomena as a starting point to propose that, in fact, many of our judgments about other people (predicting their actions, intentions, and beliefs) are built on similar overlapping representations (Gallese, Keysers, & Rizzolatti, 2004).

One problem with such accounts is that although they provide explanations of how we understand actions, they fare worse when used to explain our understanding of feelings and beliefs, especially when perceptual inputs are absent or ambiguous. There are many such cases in everyday life, such as when a depressed person has flat affect, when a healthy individual is not emotionally expressive (Zaki, Bolger, & Ochsner, 2008), when someone smiles simply to be polite (Ansfield, 2007), or when someone has a false belief that a perceiver does not share (Jacob & Jeannerod, 2005). Alternative theories propose that in these cases, perceivers use rule-based, top-down processing to dissociate representations of self and other and in this way may be able to infer states in others that differ from their own (Saxe, 2005). In this way, perceiving an ambiguous behavior may have much in common with perceiving any kind of ambiguous visual object: when an incoming percept is not correctly classified using bottom-up processes, the top-down use of an attention and stored knowledge can guide a perceiver to test hypotheses about what she is perceiving or guide her toward goal relevant stimuli (Posner, 1980).

### Upshot

On one hand, current work provides some intriguing initial models of how we engage in direct/bottom-up and reflective/top-down modes of perception, but the models have yet to explain how and when the engagement of each

mode depends on the target of judgment—self or other. On the other hand, current work has made progress toward clarifying when similar neural representations may underlie perception of and judgments about self and other, but controversies exist as to when and how such “shared representations” or common brain regions are recruited during these processing steps. In the next section, we show how simultaneously accounting for both the mode and the target of judgment may help in resolving these ambiguities.

## TOWARD A DUAL-PROCESS FRAMEWORK FOR SELF–OTHER PERCEPTION

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Before discussing the results of our division of previous work, it is worth commenting on the phenomena we chose to include in each analysis, as well as to recap our goals in this review. First, although we included various person perception phenomena from Table 2–1 in our analysis, we have chosen to emphasize the perception of emotions in self and other in our discussion. This is because emotion is the perceptual attribute most clearly present in all four cells of our processing mode \* target matrix. For example, as can be seen in Table 2–1, although one can reflect on one’s own or someone else’s traits, neuroimaging studies of *direct* processing of trait information are rare.

Second, by using a factorial approach, we hoped to isolate patterns of activations from previous studies that would map onto either a main effect of self versus other perception or onto direct versus reflective modes of processing. We then used this framework to probe for interaction effects of perceptual target with processing mode. Specifically, as discussed above, prior work had suggested that neural representations of self and other would overlap, but we expected that the extent of overlap would in some way depend on the mode of processing being engaged. Such interactions could suggest that, in fact, when considering how much people tend to view themselves and social targets as overlapping, it is critical to understand the mode they are using to view those social targets.

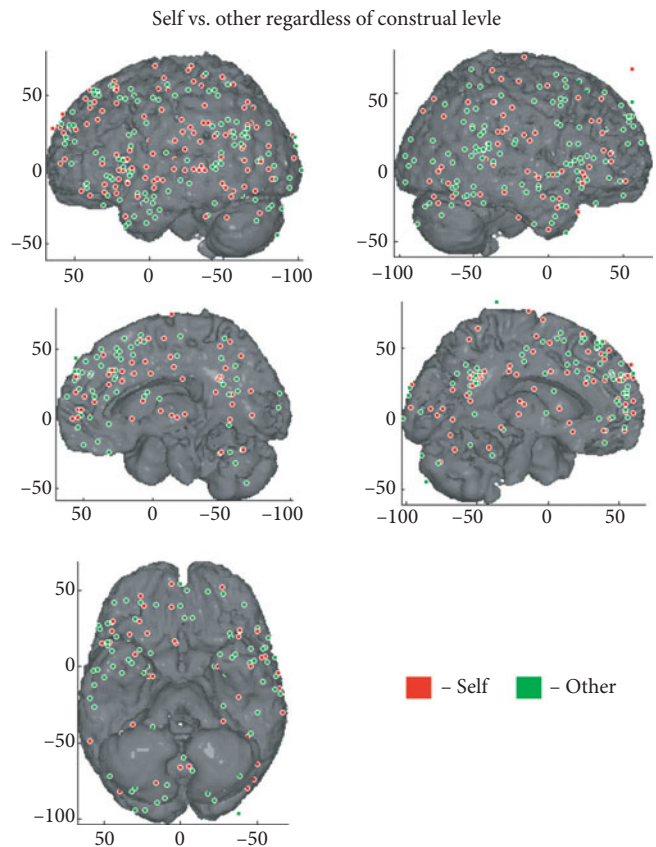


## Main Effects of Target and Processing Mode

### Type of Target: Self versus Other:

We first collapsed activations across all studies of both direct and reflective processing modes and separated them only by the target of perception to test the hypothesis that the processes used to perceive self and other are represented in discrete neural structures. The resulting images clearly show that such a broad distinction cannot be made based on brain data (Fig. 2-1). Studies of both self-perception and other perception have reported activations in regions of the brain associated with processing information about emotions, traits, and intentions. Importantly, across the large majority of studies, both the dorsal and ventral mPFC were activated regardless of whether subjects focused on themselves or someone else.

Furthermore, a host of other areas involved in emotion perception and social cognition, including the superior temporal sulci (STS), anterior insula (AI), amygdala, and posterior cingulate (PCC) were also engaged by both self-perception and other perception. Each of these regions may play important roles in person perception generally. For example, the STS has been implicated in decoding the social meaning of nonverbal cues such as eyes that vary in the direction of gaze, moving lips and forms with biologically possible motion, and tasks involving the assessment of theory of mind or trait attribution (Pelphrey, Morris, Michelich, Allison, & McCarthy, 2005; Saxe, Xiao, Kovacs, Perrett, & Kanwisher, 2004). By contrast, the AI has been implicated in representing internal bodily states, as well as in pain processing. However, it has also been shown to become active while subjects focus



**Fig. 2-1** Main effect of target (self vs. other) on neuro-imaging activation peaks.

on the pain and bodily states of other people, suggesting that it is not specific to self-perception (Botvinick et al., 2005; Keysers et al., 2004; Wicker et al., 2003). Similarly, the PCC has been associated with self-directed thought, as well as drawing attention to salient external cues (Vogt, Vogt, & Laureys, 2006). Furthermore, PCC shows high functional connectivity with the mPFC, suggesting that these regions work together during reflection about both one's self or someone else (Lou et al., 2004).

Briefly, two differences between self- and other-related activation peaks are worth noting. First, other-related activations in posterior mPFC tended to be located more dorsally than self-related activations. That is, whereas self-related activation peaks were observed along the cortex adjacent to the corpus callosum, other-related peaks were more often dorsal to the cingulate gyrus. It is known that mPFC evolved in a radial fashion, with the architectonically ancient three layered cingulate gyrus gradually developing into adjacent six-layered portions of mPFC proper. That fact rather intriguingly suggests a developmental relationship between regions involved in perceiving oneself and those involved in perceiving others. That being said, this separation is by no means complete and taken alone does not shed light on the nature of the computations performed by these regions (which are discussed below). Second, more activation peaks in the thalamus and hypothalamus occurred for self than for other. The hypothalamus is critical to regulating autonomic responses to emotionally salient stimulus and also shares connections with brain regions involved in other aspects of emotion processing, such as the subgenual anterior cingulate and orbitofrontal cortex (Morecraft, Geula, & Mesulam, 1992; Nagai, Critchley, Featherstone, Trimble, & Dolan, 2004). Activation of the hypothalamus preferentially during self-related processing may reflect increased effects of autonomic arousal and sensory processing when perceiving or making judgments about internal states than when observing or inferring the presence of such states in others.

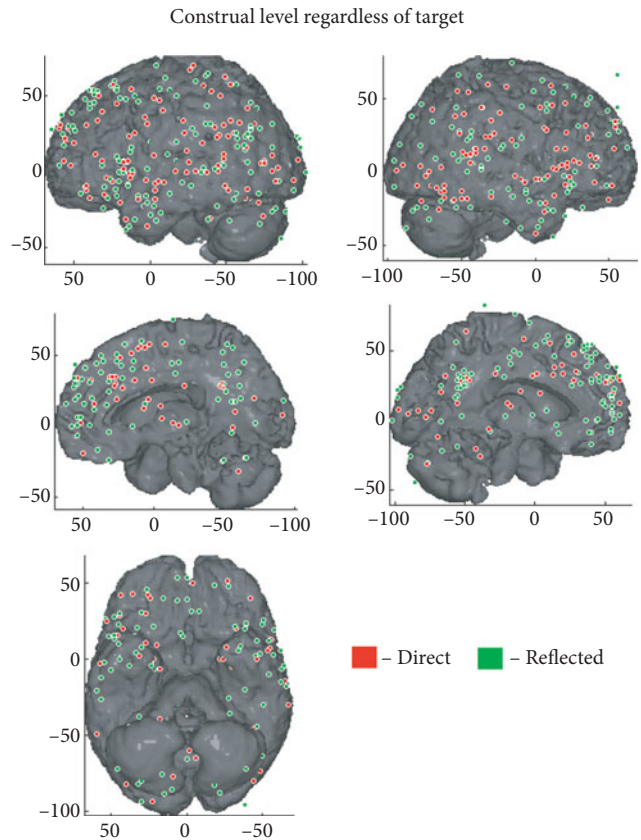
Nevertheless, the most striking pattern between self and other was that of overlap. This is not to say that there is a total overlap between the processing steps perceivers use to understand themselves and others. If this was the case, then complex social situations and crowded subway platforms would be difficult to maneuver. Still, these differences do not appear as discrete, consistent separations between targets across all task types.

#### **Mode of Processing: Direct versus Reflective:**

When collapsing across targets and instead comparing activation peaks found in studies of direct versus reflective processing, much clearer patterns of separation emerge (Fig. 2–2). This contrast showed a dissociation of activation peaks in the mPFC and ACC, such that reflective processing of traits, emotions, and mental states tended to activate more anterior points within these regions, whereas direct experience of emotion or pain more commonly activated posterior mPFC and ACC, regardless of whether the target was self or other.

This anterior to posterior gradient is consistent with the idea that high-level, reflective, secondary appraisals about one's own or another person's emotions are neurally and cognitively separable from primary appraisals of the potential threat value of stimuli, supporting findings of individual studies. For example, Kalisch et al. (2006) induced anxiety through anticipation of painful shock while subjects performed concurrent working memory tasks involving either low or high cognitive load. Although autonomic arousal and self-reported anxiety were not affected by the amount of cognitive effort the secondary task required, a rostral mPFC region became more engaged for anxiety versus nonanxiety conditions only under low load—that is, when participants could attend to their anxiety. This finding, along with many others that directly manipulate the need for high-level reflective appraisals suggests that rostral MPFC underlies appraisals of internal and emotional states when subjects can attend to and reflect on those states, but not otherwise. This is also consistent with theories about the function of (especially ventral and orbital) PFC that suggest it is a





**Fig. 2-2** Main effect of mode of processing (direct vs. reflective) on neuro-imaging activation peaks.

“zone of convergence,” integrating information about internal bodily states via connections with the hypothalamus and AI with external cues processed in the superior temporal sulci and the amygdala (Floyd, Price, Ferry, Keay, & Bandler, 2001; Mesulam & Mufson, 1982; Rolls, 2004).

By contrast, the ACC may react more automatically and in a bottom-up fashion to the presence of goal-relevant, affectively salient stimuli. In keeping with this notion, a recent study used structural equation modeling to explore effective connectivity between the PFC, ACC, and amygdala while subjects viewed emotional faces and either rated the gender of the face (incidental or direct emotion processing) or the emotion (reflective processing). During direct processing, information from the amygdala traveled to the ACC and then to the PFC, whereas during reflective emotion, this pattern was reversed (de Marco, de Bonis, Vrienaud, Henry-Feugeas, & Peretti, 2006).

Because amygdala activation can indicate an “early” cortical mechanism responding to emotional salience, the cortical region it projects to first may indicate the type of appraisal that is made about that stimuli. Thus, the connectivity pattern reported in that paper is consistent with the idea that under a reflective mode of processing, appraisals of emotional value are made in a “top-down” manner through the mPFC before reaching areas (such as the amygdala) more associated with automatic reaction to emotions of others (see also Keightley et al., 2003).

These data, along with the distribution of activation revealed by our plots, suggests that reflecting on emotional states depends on the engagement of medial prefrontal regions supporting high-level appraisal processes used to represent information about the nature of one’s own, or someone else’s, mental states. This kind of reflection may be important for other types of top-down processing, such as those involved

in cognitive forms of emotion regulation that depend on the ability to know what someone is feeling. One such strategy is known as reappraisal: actively rethinking the meaning of an emotionally charged stimulus in ways that change the trajectory of your emotional response to it. Reappraisal may involve awareness of and reflection on the nature of one's own emotional response, as well as reflection on the intentions and beliefs of others. Thus, regions associated with reflective processing of mental states may serve dual duty, helping us perform social cognitive tasks as well as regulate our emotions. In either case, mPFC may communicate with cortical and subcortical regions involved in the direct/bottom-up processing of affective cues, either amplifying or modulating their activity according to the nature of the reflective demands (i.e. amygdala; see Beauregard, Levesque, & Bourgouin, 2001; Etkin, Egner, Peraza, Kandel, & Hirsch, 2006; K. N. Ochsner, Bunge, Gross, & Gabrieli, 2002; K. N. Ochsner et al., 2004). These reflective processes could be employed in cognitive therapy, in which clients are encouraged to reflect on their emotional states and their causes to be able to effectively modulate and dampen their reactions to affective cues (Goldapple et al., 2004; Mayberg, 1997).

### Interaction Effects: Degree of Self-Other Overlap Depends on Processing Mode and Content

Our main effect contrasts for perceiving self versus other suggested that separating brain activations by the target of processing alone might resemble trying to slice a cake into the flour and sugar that went into it: although one can contemplate the separation conceptually, in actual practice, the two are hopelessly intertwined. Does this mean that the brain areas used to understand self and other are totally overlapping? Above, we hypothesized that the distinctions between processing different targets might emerge as meaningful depending on the mode of processing a perceiver engages. To test this idea, we plotted activation points for self and other for only one processing mode (i.e., either direct or reflective) at a time, thereby identifying activations associated with either direct

or reflective modes of perceiving self or other. In addition, we separated activations associated with different types of judgment and/or stimulus content. In particular, we considered whether activations might segregate for studies involving pain, emotion, or more purely cognitive judgments about nonaffective beliefs. The goal was to determine whether distinct processing systems would subservise the perception of self and other but only when engaged in direct, as opposed to reflective, processing for specific types of stimulus or judgment content.

### Direct Processing of Self and Other

Many theories suggesting an overlap between processes involved in self and other perception focus primarily on what we would term direct processing. As described above, these theories have relied mostly on data from studies of mirror neurons and their engagement during the observation of motor actions (Brass & Heyes, 2005; Jarvelainen, Schurmann, & Hari, 2004) as well as mirror-like responses during perception of pain, disgust, and touch in other people. Such studies of self-other neural overlap have influenced suggestions that perceivers understand social targets by automatically activating their own sensory, motor, and affect systems. In the following two subsections, we review studies exploring overlap in the neural systems used to perceive pain and emotion in the self and others.

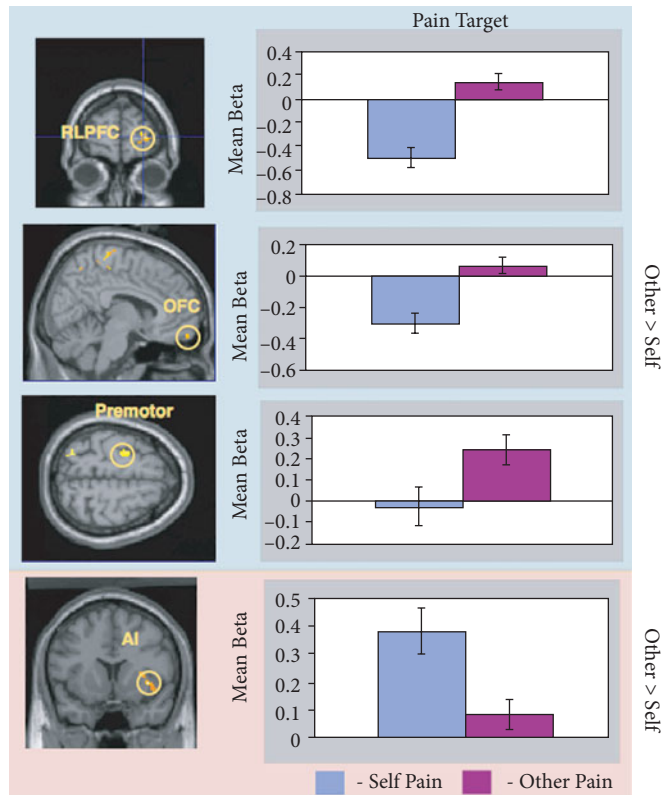
*Pain* One of the most compelling cases for overlap in the brain systems involved in self-other perception comes from the results of studies of pain. It is important to our survival that nociceptive (i.e., noxious and painful) signals allow us to pull away from a hot stove; equally important is our ability to learn not to touch a stove someone else has pulled away from in pain. For more than two decades, vicarious conditioning studies have provided a laboratory model of this phenomenon by showing similar skin conductance and heart rate responses when perceivers observe others learning to “fear” conditioned stimuli and when the perceivers themselves are being conditioned (Olsson & Phelps, 2004; Vaughan & Lanzetta, 1980). Imaging studies have focused on a parallel phenomenon,

known as “empathic pain,” and have observed activity in overlapping regions of ACC and AI both when one experiences pain directly and when one sees someone else experiencing pain (Botvinick et al., 2005; Jackson, Brunet, Meltzoff, & Decety, 2006; Morrison et al., 2004; Singer et al., 2004). The fact that these two regions are associated primarily with affective responses to painful stimuli have been taken to suggest that instead of understanding someone else’s pain in a cold and cognitive manner, we feel it as we would our own.

Although the finding of overlapping activity for self and other pain has been highly influential to theories of empathy, important differences for self-pain and other pain have been observed. The process of understanding someone else’s pain requires not just an affective response to that pain but a number of additional processing steps as well. For example, one might need

to attend to nonverbal, visual cues such as facial expression or body language that can be indicative of another person’s response to a painful stimulus. What’s more, some understanding of the motivational relevance of a painful situation for someone else may be used to constrain one’s understanding of a target’s pain experience. Theoretically, these additional types of processing steps should recruit neural systems beyond those commonly supporting the representation of pain affect in self and other, including medial prefrontal regions described earlier that are important for reflecting on the nature of one’s mental states and posterior cortical regions (such as the STS) important for interpreting nonverbal cues. By contrast, the direct perception of one’s own pain may differentially depend on regions important for the perception of one’s own body and the generation of physiological responses important for coping with a noxious stimulus. Regions such as

Interaction of Pain with Self/Other Targets



**Fig. 2-3** Interaction effects from our recent study of empathy for pain (Ochsner et al., 2008). Orbitofrontal (OFC) and rostralateral prefrontal cortex (RLPFC), as well as premotor regions, became more active during “other pain” as opposed to self pain. The anterior insula (AI) showed the opposite pattern.

the anterior insula, hypothalamus, and thalamus (described earlier as being important for perception of bodily states and sensations) might be expected to play an role in these processes.

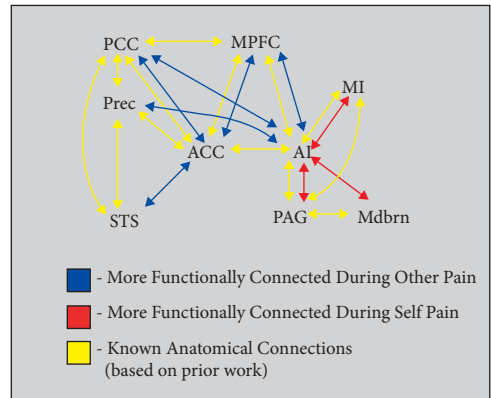
To explore this possibility, Ochsner and colleagues (Ochsner et al., 2008) had participants complete two tasks: in a self-pain task, participants were exposed to both nonpainful and painful thermal stimuli; in an other pain task, participants viewed of others in painful and nonpainful situations. As has been shown in previous work, we identified overlapping regions of AI and ACC more active for painful than for nonpainful stimuli in both tasks. In addition, we found that perception of pain and others preferentially engaged a host of additional regions associated with reflective processing of mental states, including orbitofrontal cortex and rostrolateral PFC. By contrast, posterior sections of the AI were preferentially engaged by self-pain (Fig. 2–3). These findings suggested that as a common affective pain matrix is engaged by both self-pain and other pain, additional functional systems are necessary to fully decode the meaning of painful experiences experienced personally or perceived in others.

We further hypothesized that although self-pain and other pain both involve activation of the AI and ACC, this activation may be part of different cognitive and neural network activity in each case. To test this, we employed functional connectivity analyses. Whereas main effect contrasts that average activity across time and individuals may be insensitive to regions whose activity across two conditions co-vary, functional connectivity analyses are sensitive to such dynamic fluctuations (Friston et al., 1997). In the context of empathy for pain, these analyses showed that during other pain as opposed to self-pain, overlap areas in the ACC and AI become more connected to mPFC regions associated with theory of mind, whereas during self-pain, ACC and AI become more connected to the hypothalamus and periaqueductal gray regions associated with processing autonomic responses (Zaki, Ochsner, Hanelin, Wager, & Mackey, 2007). Based on these findings, we created a schematic representation of brain networks involved in perceiving self-pain and

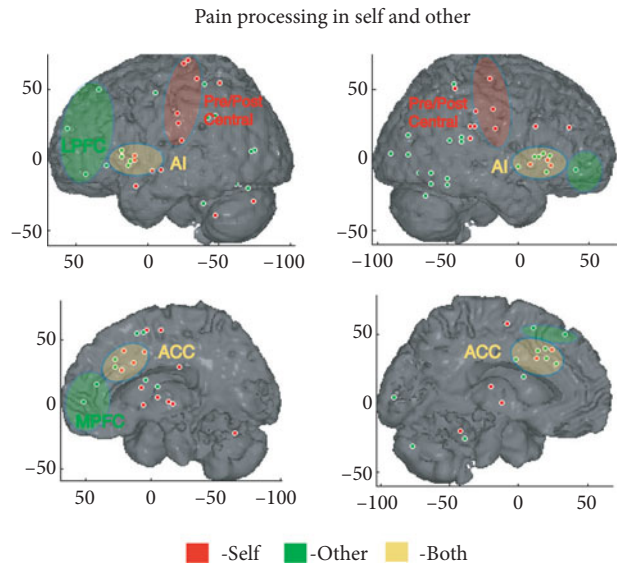
other pain (Fig. 2–4). Such a model can be used as an example of dissociating a seemingly similar process in self and other by probing interaction effects in the brain.

To provide further support for the dissociation of self-processing and other processing in the context of pain, we plotted activations from previous studies of pain perception in self and other (Fig. 2–5). Although the authors of these studies emphasized overlap for self-perception and other perception in the affective pain matrix, Figure 2–5 shows that there are important differences as a function of the target of pain. Whereas self-pain more commonly activates the thalamus and areas along the central sulcus, other pain activated mPFC, bilateral ventrolateral PFC, and OFC, as well as visual association areas. Furthermore, all activation peaks anterior to the genu of the corpus callosum, representing associative regions of PFC, occurred during other pain perception only.

Although these differential activations seldom are discussed in theoretical accounts of



**Fig. 2–4** A circuit model diagramming the interaction of brain areas during self and other pain only, as well as interactions occurring during both types of pain. Connections in the model are based both on connectivity analyses from Zaki et al. (2007), and on existing information about intrinsic physical connections between these regions. mPFC, medial prefrontal cortex; STS, superior temporal sulcus; MI, mid insula; ACC, anterior cingulate cortex; AI, anterior insula; PAG, periaqueductal gray; Prec, precuneus; PCC, posterior cingulate cortex; Mdbn, Midbrain.



**Fig. 2–5** Neuro-imaging activation plots demonstrating the effect of target (self vs. other) on pain perception.

empathic pain, they are important in at least two ways. First, they suggest that although neural overlap between self-pain and other pain processing may exist in the ACC and AI, the functional role of activity in these regions may differ in each context, depending on the additional regions with which the ACC and AI are interconnected. Second, they provide means for explaining paradoxical effects of viewing pain in certain contexts. For example, during competition, one's own goal and those of someone else directly conflict. In these cases, it may be adaptive for perceivers to "turn off" otherwise automatic reactions to the pain of others (e.g., during athletic competitions or, more extremely, during war). In keeping with this notion, both autonomic and neural activity evoked by watching others in pain is reduced or reversed when the people in pain are in an adversarial or competitive relationship with a perceiver (Lanzetta & Englis, 1989; Singer et al., 2006). Under the hypothesis that processing of pain in self and other largely overlap, these effects would be difficult to explain. However, the recruitment of prefrontal regions important for perceiving the intentions of others could modulate the amount of AI and ACC activity perceivers engage while observing another person in pain, depending

on how a perceiver feels about or relates to that target.

*Emotion* Emotional stimuli do not necessarily require reflective awareness of them to affect the way we feel, act, or engage in cognitive processing. This fact was taken advantage of by the producers of *The Exorcist*, who included grotesque subliminal images in their film, causing moviegoers to become terrified and nauseated while watching the film although they couldn't quite pinpoint why. Before being discovered, these producers managed to show, in thousands of unwary subjects, the extent to which emotional cues we do not experience consciously can affect our mood. Importantly, emotion without reflection can affect other aspects of our cognitive and even perceptual functioning, such as how much money we will spend while shopping or the part of a photograph to which we attend (Gasper & Clore, 2002).

Perception of emotional cues without reflection also has discrete neural correlates. Masked emotional stimuli can cause amygdala activation outside of awareness (Whalen et al., 2004; Whalen et al., 1998), although this finding has been contested (Pessoa, Japee, & Ungerleider, 2005; Pessoa, McKenna, Gutierrez,



& Ungerleider, 2002). Interestingly, the amygdala is preferentially engaged by faces displaying fear, even over other potentially threat-related emotions such as anger (Whalen et al., 2001). Given that the amygdala is connected to sensory systems via only a few synapses, this suggests that some of the fastest processing we use to assess potential threat may rely on cues about the emotional experiences of others who may be responding to something we should be avoiding. This possibility raises what by now should be an obvious question: Does the neural activity accompanying perception of someone else's fear resemble the neural activity we exhibit in response to our own fear? Or, to extend William James' already overextended phrase, does a perceiver become frightened by *someone else* running from a bear? If so, does that perceiver's fear originate in an understanding of the frightened sprinter, or does the perceiver simply become primed for fear and vigilance outside of his awareness?

A few studies have argued that the latter may be true. This work extends the logic of studies examining so-called "shared representations" to the domain of perceiving facial expressions of emotion. By and large, findings have supported the theory that when we see someone else's emotional face, we "feel" the same thing they do, by virtue of activating brain regions similar to those activated when we experience the emotion we see them expressing. For example, both seeing and imitating emotional facial expressions activates the amygdala and AI (along with classic mirror neuron regions in the inferior frontal and premotor cortices), suggesting overlap between perception and sensation of emotions (Carr et al., 2003; but see also Leslie et al., 2004).

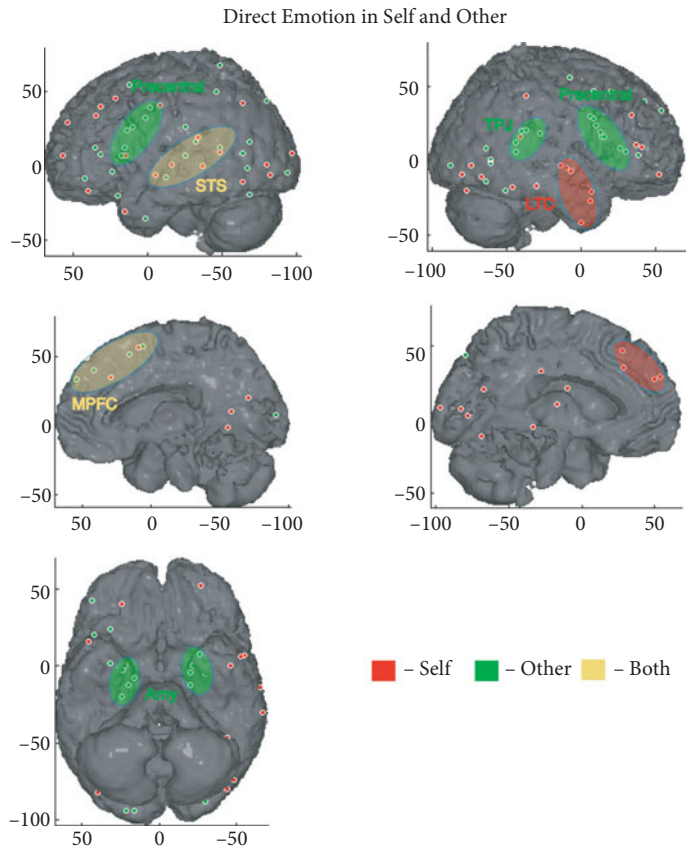
Although these data suggest that direct processing of self-emotion and other emotion cues may recruit at least partially overlapping neural circuitry, this is certainly not the entire story. Although the amygdala is associated with generating physiological components of emotional responses, an early meta-analysis of emotions found that more frontal regions, including the mPFC and ACC, are actually the most commonly recruited by emotional stimuli

(Phan et al., 2002), and more recent meta-analyses suggest that these regions are associated with emotional experience, whereas the amygdala is not (Barrett, Mesquita, Ochsner, & Gross, 2007). Furthermore, an observational learning paradigm found that while watching someone else receive shock activated the amygdala, only subjects' own fear of being shocked engaged ACC (Olsson, Nearing, & Phelps, 2007). This suggests that the perception of emotions experienced by another person may commonly trigger a "warning bell" to the self that danger is present but does not engage prefrontal systems associated with higher-level, reflective processing of mental states and intentions.

To parse the regions associated with processing of self-emotion and other emotion cues under direct and reflective modes of processing, we selected activation peaks from a group of emotion-related neuroimaging studies. In doing so, we defined a "direct" mode of emotion processing as any emotional response that a subject experiences or sees someone else experience but does not attend to or judge explicitly. Contrasts were included in the "direct self" category if they asked participants to passively look at aversive or amusing scenes or videos or required participants to make a nonemotional judgment about those stimuli (e.g., "was this photograph taken indoors or outdoors?"). Contrasts were included in "direct other" category if they asked participants to passively attend to or make nonemotional judgments about emotionally expressive faces or body movements.

Resulting plots are shown in Figure 2-6. The greatest degree of overlap between direct processing of self-emotion and other emotion cues occurred in anterior and posterior sections of mPFC, dorsal to the genu of the corpus callosum. These regions have been shown to respond to emotional stimuli in general (Phan et al., 2002) but, as reviewed above, also respond during tasks requiring reflective processing of mental states including, theory of mind tasks and action monitoring (Amodio & Frith, 2006). Self and other stimuli also produced heavily overlapping patterns of activity





**Fig. 2-6** Neuro-imaging activation plots demonstrating the effect of target (self vs. other) on the direct processing of emotion.

in left STS regions associated with the perception of nonverbal social cues (Pelphrey, Morris, & McCarthy, 2004).

The fact that these regions are engaged both by reflective processing of social targets in general, and by the direct processing of affective cues regardless of target, highlights the important role that understanding the intentions of others plays in appraising the affective significance of stimuli. Indeed, many appraisal theories of emotion postulate that specific computations about the intentions of others determine whether or not we feel angry or sad, happy, or surprised in response to the actions of other people (Scherer, Schorr, & Johnstone, 2001).

Perhaps as important as these regions of overlap, self-processing and other processing of emotion also showed disparate patterns of activations in several brain regions. Although “direct other” emotional stimuli more commonly activated

bilateral premotor cortex, amygdala and right temporoparietal junction (TPJ), “direct self” emotions showed unique activation peaks along the right temporal pole, medial occipital lobe, and thalamus. The premotor and TPJ activations in the “other” condition are consistent with previous accounts of “motor empathy” in which covert imitation plays some role in processing emotional cues from others (Iacoboni, 2005; Iacoboni et al., 1999). The TPJ is often associated with making inferences about the mental states of others (Saxe & Kanwisher, 2003; Saxe & Wexler, 2005) as well as the disengagement of spatial attention more generally (Corbetta, Kincade, Ollinger, McAvoy, & Shulman, 2000); as such, its presence preferentially in “other direct” emotion may suggest attempts to orient to alternative interpretations of other people’s affective responses. The activation of amygdala during other emotion, and of the thalamus in

self emotion, respectively, suggests that qualitatively different processes underlie each type of emotion. In keeping with our discussion of the perception of pain, perceiving emotions in others may depend on systems sensitive to detecting potentially goal relevant features of the environment, whereas experiencing our own emotions may involve greater monitoring of internal bodily states.

*Summary* In reviewing studies of pain and emotion, we found that under a direct mode of processing, the brain regions engaged by perceiving self and other partially overlap, corresponding with the emphasis of many studies on so-called “shared representations” in empathy and social cognition. These overlaps occur mainly in cortical regions (i.e., AI and ACC) used for integrating emotional cues or sensations into coherent second order (i.e., nonsensory) representations of affective states. However, we also found striking dissociations between self- and other-related activation peaks. Specifically, watching others feeling pain or expressing emotion engaged motor cortex, which may help us understand intentions underlying others’ actions, as well as the amygdala, which may trigger vigilance in response to the perception of others feeling threatened. On the other hand, the experience of self-pain and emotion consistently involved postcentral gyrus, thalamus, and hypothalamus—areas associated with processing information about bodily states and sensations. Furthermore, connectivity analyses of perceiving pain in the self and in others revealed that only other pain causes ACC and AI to become functionally connected with the mPFC, an area associated with mental state inference (Zaki et al., 2007). Together, these findings indicate that although perceivers may experience responses to their own pain and emotion that are similar to those experienced when they perceive pain and emotion in others, the functional networks through which these sensations are created may be importantly different.

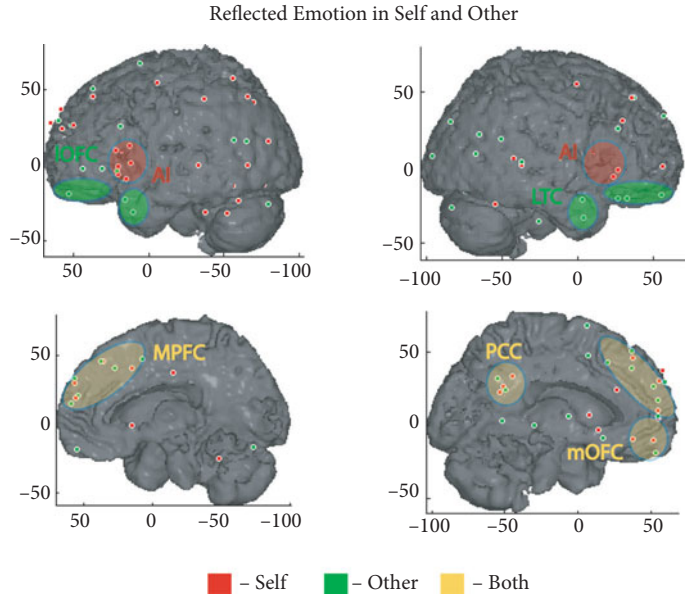
### Reflective Processing of Self and Other

The patterns of dissociation between self and other we observed when participants are in a direct mode of processing are the product of

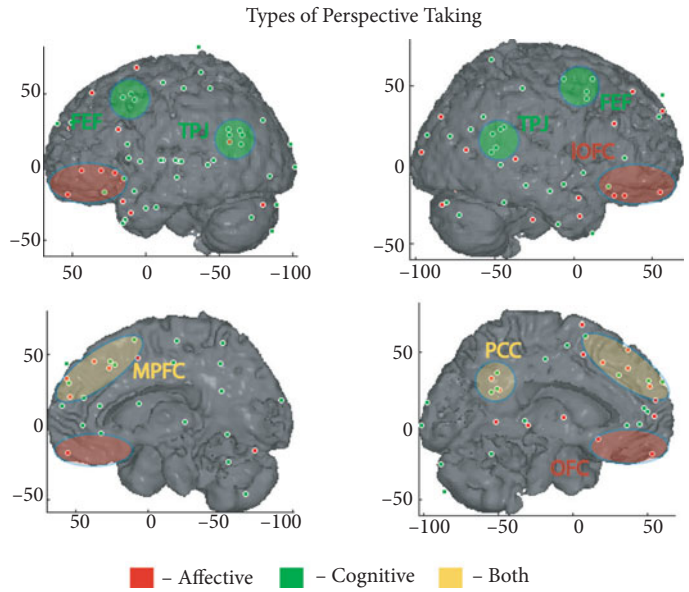
differential recruitment of systems important for processing be sensory information available for direct personal experience as compared to the indirect observation of others. To the extent that reflective processing integrates lower-level sensory and perceptual cues into higher-order representations, we would expect similar systems to support the reflective processing of multiple types of cues, including those associated with the perception of emotion in oneself and other people.

*Emotion* To explore this hypothesis, we plotted activation peaks from several studies of reflective emotion processing in Figure 2–7. To date, there are few studies of the reflective processing of pain. As described above, we constrained our plots to show the results of main effect contrasts requiring explicit judgment of affective states. The “reflective self” category included any contrast in which participants were asked to rate their own experience while viewing emotional stimuli, whereas the “reflective other” category included contrasts where participants rated the emotional state of someone else in a picture, vignette, or cartoon. We included both contrasts comparing judgment to no judgment and contrasts comparing affective judgments to judgments about external stimulus features (e.g., emotional state vs. gender of someone in a picture). Because we were also interested in the relationship between qualitatively different types of reflections about others, we plotted “reflective other” studies in which subjects made nonemotional mental state judgments about others in vignettes, pictures, and cartoons separately from those where participants made judgments about the enduring personality traits of targets (which, in all cases, involved both emotional and nonemotional judgments, Fig. 2–8).

Several distinctions emerged in these plots. First, reflective emotion processing showed several regions of overlap for both self-targets and other targets. These overlaps included activations in precuneus and posterior cingulate cortex (PCC), the mPFC, bilateral temporal poles, and medial OFC. These findings are important because virtually all of these regions have been



**Fig. 2-7** Neuro-imaging activation plots demonstrating the effect of target (self vs. other) on reflective processing of emotion.



**Fig. 2-8** Neuro-imaging activation plots demonstrating the effect of perspective taking type (cognitive vs. affective) on neural activity.

previously described as important for mental state attribution in general (Frith & Frith, 2003). The present analysis highlights once again the importance for emotion of regions previously associated with social cognition and mental state attribution in general. Activity in numerous subregions of mPFC, including anterior and

ventral portions of this region, was not surprising, given that mPFC is central to both inferences about internal states (Amodio & Frith, 2006; Mitchell, Neil Macrae, & Banaji, 2005) and emotional experience, as described earlier.

Activity in two additional overlap regions—the precuneus and PCC—is worthy of additional

discussion, as they have not been discussed previously. Activity in the precuneus is often related to both visuospatial imagery and self-focused attention (Cavanna & Trimble, 2006; Gusnard, Akbudak, Shulman, & Raichle, 2001; Kelley et al., 2002) visual perspective taking in a first person (Vogeley & Fink, 2003) or third person (Ruby & Decety, 2001) point of view. Importantly, the precuneus does not have connections with any primary sensory cortices but does have efferent connections to the STS and ACC and may be involved in directing attentional resources to salient social or emotional stimuli (Lou et al., 2004). Similarly, the PCC is often recruited in self-referential mental and emotional tasks, and Vogt et al. (2006) have suggested that ventral PCC may play a part in a ventral attentional stream, sending information about potentially salient stimuli to the vACC through direct reciprocal connections. Together, common activation in these regions suggests that perceivers use similar mechanisms for self-perception and other perception to direct attentional resources to emotional cues.

Dissociations between activity associated with reflective judgments of self and other were subtler than the analogous differences described in the context of direct emotion processing. These differences may be less reliable and are deserving of attention and future research designed to unpack their functional significance. For present purposes, we merely note reflective judgments of other people's emotions more commonly recruited extrastriate and medial occipital cortices, which is consistent with the fact that these tasks involved explicit attention to people, mostly in visual scenes. In addition, whereas self-related judgments more commonly recruited inferior frontal regions, other-related judgments more often recruited lateral orbitofrontal regions. Given that both of these regions are associated with response selection and response in addition, and that their precise computational roles remain a hot topic of debate, it is not yet clear what this result might mean.

Overall, however, the most striking feature of these plots is the commonality of activity regardless of the target of perception. Importantly, this

differs from the pattern observed for direct processing of emotion, which showed recruitment of both common and distinct regions for self and other. Together, these patterns suggest that when the self or someone else is viewed as an object of reflection, a network of regions comes into play that is involved in directing attention, interpreting social cues, and inferring internal states. By contrast, in the absence of reflective processing, the direct and bottom-up perception of emotion from low-level cues recruits different systems depending on the type of perceptual input associated with each target (visceral for self vs. visual for other).

*Distinct neural substrates for different types of reflective judgment*The reflective mode of processing offers myriad possible ways of attending to, and elaborating on, our judgments about ourselves and other people. We might, for example, think about how someone feels as compared to what they are thinking, and such differences in focus might involve different underlying neural circuitry. To determine whether the way in which we reflect on our own or others' mental states depends on different underlying neural systems, we examined separately activations related to emotional as compared to nonemotional mental state judgments (i.e., false belief tasks). This analysis revealed a dissociation in brain regions recruited by cognitive as opposed to affective inferences about other people (Fig. 2–8). Whereas cognitive judgments more commonly recruited bilateral TPJ and frontal eye fields (FEFs), affective judgments more commonly recruited orbital frontal and anterior vmPFC regions.

TPJ is associated with mental state judgments (Saxe & Kanwisher, 2003; Saxe & Wexler, 2005) and also with shifting attention towards behaviorally relevant stimuli in—for example, external cueing tasks (Kincade, Abrams, Astafiev, Shulman, & Corbetta, 2005). FEF is engaged during tasks requiring increased attention to and working memory for visuospatial stimuli, including when one attempts to inhibit reflexive tendencies to shift one's eyes toward a visual stimuli (Curtis & D'Esposito, 2003). Activations in these regions when drawing inferences about

cognitive, but not affective, states could suggest that cognitive inferences depend to a greater extent on the mental manipulation of information about stimuli in the external world. This could especially be the case given that often (as in a false belief task), cognitive inferences require participants to keep two disparate mental states (their own and their target's) in mind, as well as overriding the prepotent desire to impose their own mental states and knowledge on a target. Theory of mind critically relies on executive function—and especially on inhibitory control—and the two develop in parallel (Carlson & Moses, 2001). When our own perspectives and someone else's differ (i.e., we have knowledge that a target does not), making accurate judgments about their state requires us to adjust from our own state, a process that is attentionally demanding. Activation of FEF and TPJ during mental state inference may reflect the unique attentional demands of keeping multiple mental states in mind simultaneously.

Engagement of OFC and related ventral mPFC regions when drawing affective inferences could be related to the role these regions play in representing the motivational value of stimuli. Single-unit recording, lesion, and functional imaging studies of conditioning and reinforcement learning have long implicated OFC and ventromedial PFC in representing the current motivational or affective value of stimuli as it changes over time as a function of one's current goals (Barrett et al., 2007; Rolls, 2004). OFC also shares strong connections with the hypothalamus, which projects to brain-stem nuclei controlling autonomic outflow, and its activity has been shown to co-vary with skin conductance responses (cf. Nagai, Critchley, Featherstone, Fenwick et al., 2004). By contrast, the amygdala has been thought to encode relatively enduring, context-free and stimulus-driven associations between perceptual cues and physiological responses (Schoenbaum, Chiba, & Gallagher, 1999). The OFC could therefore play an important role in representing either one's own or another person's current affective state.

This hypothesis could explain the role of OFC in the perception of emotion in self and other. Consider, for example, the results of a recent

study in which participants saw emotional or neutral pictures and then rated their affect for the subsequent 20 seconds after the pictures disappeared. After viewing negative pictures, subjects commonly reported feeling sustained emotion after the picture itself was gone. Although time-courses of amygdala activity tracked with the presence of negative pictures, lateral OFC activity tracked participants' sustained self-reported emotional response (Garrett & Maddock, 2006). In this study, OFC reflects the personal experience and generation of an emotional response to a stimulus. Interestingly, antisocial and psychopathic patients, as well as patients with orbitofrontal and vmPFC damage, show blunted autonomic reactions to expected stressors (Bechara, Tranel, Damasio, & Damasio, 1996; Raine, Lencz, Bihrl, LaCasse, & Colletti, 2000), as well as in anticipation of unpredictable stressors (Roberts et al., 2004). This suggests that they may be unable to generate context-appropriate affective responses.

Now consider the results of other studies suggesting that affective representations in OFC may help us understand the emotions generated in other people. OFC patients don't understand social faux pas (Stone, Cosmides, Tooby, Kroll, & Knight, 2002) and also fail to experience normal levels of self-conscious emotion in social interactions that would engender either pride or embarrassment in healthy individuals (Beer, Heerey, Keltner, Scabini, & Knight, 2003). Self-conscious emotions like these are important in social interactions because they tell us when our own behavior has had intended (pride) or unintended (embarrassment) consequences for others. To the extent that damage to OFC renders us unable to experience these emotions normally, we may become inappropriately boastful, forward, or rude.

*Summary* Comparisons of patterns of neural activity associated with a reflective mode of processing for self and other showed much more overlap and fewer differences than did the same comparison for the direct mode of processing. This suggests that when making explicit judgments about people, perceivers tap into a common set of cognitive and affective processes



regardless of whether they are reflecting about themselves or someone else. Perceivers direct their attention to salient cues, infer internal states, and also create corresponding autonomic and emotional states in themselves when trying to infer emotions in others and when inferring false beliefs may use inhibitory control to separate their point of view from their target's.

### CONCLUSIONS AND FUTURE DIRECTIONS

Now that we have taken this whirlwind tour of the data on direct and reflective modes of processing for self and other targets, we can take a moment to recap where we've been and then revisit some questions we began with to see if we're any closer to answering them than when we started.

The premise of this chapter was that we could gain insight into the processes mediating perception of one's own feelings and thoughts, or those of other people, by using data from functional neuro-imaging studies. We felt that that common and distinct patterns of activity associated with the mode of processing—reflective or direct—and the target of perception—self or other—could be used to address this question. Our method was to perform a qualitative meta-analysis of studies examining the perception of one's own or other people's affective states. Our results suggested two conclusions. First, when perceivers reflect on the emotions of others, they do so using mechanisms similar to those they use to process their own emotions. Second, in the absence of reflective attention, overlapping but distinct processes are used to represent your own or other people's affective states.

Do these data help us understand whether representational overlap between of our own emotions and those of others allow smooth navigation of the social world, and whether it could stimulate prosocial behavior, as suggested in *I Heart Huckabees*? This question is important not just because it relates to the fanciful premise of a moderately successful existential film but because the ability of neuroscience data to address it may provide a litmus test for our current SCN models of social behavior.

Not coincidentally, this question is also the subject of a longstanding debate in social psychology. Daniel Batson and colleagues have argued that we help others because of a selfless *empathic concern* we feel for them. For example, in a series of studies, Batson asked participants to decide whether they would like to perform a fun task with the potential of earning money or a boring task for which they would not get paid. Whichever task they did not choose would be given to another person whom the participant would not meet. An experimenter gave each participant a coin to flip in case they wanted to make a "fair" choice. Before deciding, subjects were either (1) not given instructions, (2) told to imagine themselves in the other person's situation, or (3) told to think of the other person's feelings while they made their decision. Thinking of oneself in someone else's situation caused participants to flip the coin more but not to assign the other person to the more desirable task, whereas thinking of the other person's emotions at the time caused most participants to take on the more boring task for themselves (Batson et al., 2003). These results and others support Batson's view that perspective taking and emotional empathy are at the root of prosocial behavior towards others (Batson et al., 1991; Batson et al., 1988), including social out-groups toward whom we might otherwise find threatening (Batson et al., 1997; see also Eisenberg & Miller, 1987).

Other researchers have disagreed, however, with Batson's idea that prosocial behavior is impersonal or selfless in nature. Several studies have claimed that the effect of empathy on prosocial behavior is moderated (or replaced) by a sense of similarity—or overlap—between self and other. That is, we help people only because we feel connected to them in some way, and their suffering causes us suffering as well (Cialdini, Brown, Lewis, Luce, & Neuberg, 1997; Cialdini et al., 1987). From this viewpoint, empathy may create a feeling of similarity between a participant and the person whose perspective they are taking (Davis, Conklin, Smith, & Luce, 1996). In the end, Cialdini and colleagues argue that it is only because of a desire to reduce our own suffering that we choose to help others. For



example, one study related volunteer AIDS workers' motivation to their resulting helping behavior and found that empathic concern moderated helping only if the patient that volunteers worked with was a member of their in-group. This effect was replicated in a laboratory paradigm testing spontaneous helping behavior for a confederate who participants believed had hepatitis (Sturmer, Snyder, & Omoto, 2005).

If helping behavior is driven by an observer's own distress while seeing someone else's suffering, then it makes sense that we should preferentially help those closest to us. Although it is painful to read news stories about natural disasters happening in foreign countries, this pain may be fundamentally different from what we feel when a friend or family member is injured. In line with this suggestion, individuals are more likely to ascribe secondary emotions (i.e., shame, pride) to in-group members, suggesting that we attend more to their emotional states, allowing us to feel a greater sense of overlap with them and to feel more distress at their distress (Leyens et al., 2000). Group membership in this context can be defined by a situation, rather than by traits such as race or gender. This could explain the lack of empathy subjects had for competitors in Lanzetta (1989) and Singer's (2006) work.

Does our review of the neuro-imaging literature on self-perception and other perception suggest that helping behavior is mediated by emotional perspective taking (as claimed by Batson) or that it instead depends on an overlap between self and other (as claimed by Cialdini and others)? Our review indicates that although self-perceptions and other perceptions differ importantly when one is processing information in a direct, unreflective manner, paying attention to someone else's emotional state increases the similarity of regions used to perceive one's own emotions and those of another person. In other words, to the extent that an observer attends to and reflects on the emotional states of a target, a richer, more reflectively elaborated representation of that target's state begins to emerge for the observer. Behavioral data converges with imaging data by suggesting that this reflective representation more closely approximates how

the observer views herself: perspective taking causes observers to rate targets as more similar to themselves (Davis et al., 1996) and to engage more overlapping neural activity when judging themselves and targets (Ames, Jenkins, Banaji, & Mitchell, 2008).

Applying our models of the brain bases of self and other perception to real-world dilemmas such as the motivations for prosocial behavior remains a speculative pursuit but one which we feel can nonetheless be fruitfully expanded through further use of brain imaging data. Hopefully, this chapter has served to illustrate how such data can be used begin building theories of person perception that link psychological processes to their neural bases. It remains for future work to take the next step and link this work directly to behavior in prosocial contexts to determine whether the presence of "shared representations" truly mediates one's desire to help, or at least makes one feel like part of an existential blanket.

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