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Theory of Mind and Empathy as Multidimensional Constructs

Neurological Foundations

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Empathy describes an individual's ability to understand and feel the other. In this article, we review recent theoretical approaches to the study of empathy. Recent evidence supports 2 possible empathy systems: an emotional system and a cognitive system. These processes are served by separate, albeit interacting, brain networks. When a cognitive empathic response is generated, the theory of mind (ToM) network (i.e., medial prefrontal cortex, superior temporal sulcus, temporal poles) and the affective ToM network (mainly involving the ventromedial prefrontal cortex) are typically involved. In contrast, the emotional empathic response is driven mainly by simulation and involves regions that mediate emotional experiences (i.e., amygdala, insula). A decreased empathic response may be due to deficits in mentalizing (cognitive ToM, affective ToM) or in simulation processing (emotional empathy), with these deficits mediated by different neural systems. It is proposed that a balanced activation of these 2 networks is required for appropriate social behavior.
Key words: *emotion*, *empathy*, *inferior frontal gyrus*, *mirror neurons*, *simulation*, *theory of mind*, *ventromedial prefrontal cortex*

ONE of the core functions of individuals living within a society is the attribution of mental states to others. This function, known as theory of mind (ToM) or "mentalizing" (Frith, 1999), enables an individual to understand or predict another person's behavior and to react accordingly. Much of the research on ToM has viewed it as a unitary construct, focusing on cognitive mentalizing about others—thinking about the thoughts, intentions, and beliefs of others. Technological advances in neuroscience enabling the investigation of neurophysiological functioning have provided evidence of the multidimensional nature of ToM. In this article, we review main approaches to the study of the neural basis of ToM and empathy (including tasks used to elicit them), describe the neurological underpinnings for the multidimensional nature of ToM and empathy, and discuss these findings in relation to clinical interventions.

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ToM AND EMPATHY

The ability to infer the thoughts and feelings of others is critical for appropriate and effective social interactions and discourse comprehension, but it is not sufficient. Belief understanding does not guarantee emotion understanding; emotion understanding does not guarantee empathy; and empathy does not guarantee sympathy as manifested by kindness to people (Davis & Stone, 2003). Hence, empathy is the link between knowing the thoughts and feelings of others, experiencing them, and responding to others in caring, supportive ways.

Theory of mind is part of a person's empathic ability, a broader term that also encompasses the emotional aspect of inferring and sharing the emotional experiences of another. Empathy is a central theme in the psychological sciences, as well as in neuroscience, and has become a prominent field of research in recent years. Empathy describes an individual's ability to understand and feel the other. Because empathy links one's feelings about the self to feelings about the other, it is a fundamental part of the social fabric of emotion. In examining empathy and ToM, the natural focus of cognitive and psychodynamic psychologists is on psychological processes rather than on brain mechanisms. Yet, recent experimental studies have shown that impaired empathy is observed in both neurological and psychiatric populations, suggesting that empathy may be mediated by dedicated neural networks (Brothers, 1990).

Researchers and clinical personnel are expressing increased concerns regarding "loss of empathy." In Great Britain, Baron-Cohen (2011) published the book, *Zero Degrees of Empathy*, in which he describes patterns of ToM skills and empathy deficits in persons with autism, Asperger's syndrome, and a variety of psychiatric conditions.[1] In the book, *Born for Love: Why Empathy Is Essential and Endangered*, Perry and Szalavitz (2010) explain how empathy develops or is threatened as a result of genetics and social interactions. The most recent version of the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (American Psychiatric Association, 2013), added specifiers regarding "callous-unemotional" behaviors to the diagnostic criteria for disruptive behavior disorders in children. These specifiers describe behaviors associated with deficits in empathy (e.g., callous disregard of the feelings of others) and affective interpersonal ToM (e.g., lack of remorse or guilt; shallow or deficient affect).

Broadly speaking, empathy refers to the reactions of one individual to the observed experiences of another (Davis, 1994). Some scholars view empathy as a cognitive process, stressing the ability to engage in the cognitive process of adopting another individual's psychological perspective. This process, which can be termed *cognitive empathy* (and when including an inference on affective aspects can also be known as affective ToM or affective cognitive ToM), may be defined as an active attempt by one person to get "inside" another's mind or to approach someone mentally through a deliberate intellectual effort. In other words, cognitive empathy describes a situation in which the subject is an active agent deliberately attempting to step outside the self and "into" the other's experiences; it involves a cognitive recognition of the emotions of others. This process may involve perspective taking (Eslinger, 1998) and ToM (Shamay-Tsoory, Tomer, Goldsher, Berger, & Aharon-Peretz, 2004). It is thought to be dependent on several cognitive capacities, such as cognitive flexibility and memory (Davis, 1994; Eslinger, 1998; Grattan, Bloomer, Archambault, & Eslinger, 1994).

Other studies in the field have used a definition of empathy that showcases its affective aspects. Such studies refer to the ability to experience affective reactions to the observed experiences of others as "affective empathy" (Davis, 1994). According to this view, empathy may be regarded as an emotional reaction of the observer when perceiving that another is experiencing or is about to experience an emotion. There is, however, a critical difference between cognitive empathy (affective cognitive ToM) and emotional or affective empathy. Whereas cognitive empathy involves cognitive understanding of another person's perspective, emotional empathy includes appropriating these feelings, at least on a gross level (pleasant-unpleasant; Mehrabian & Epstein, 1972). Previously, it was argued that the various aspects of empathy are interrelated and interact throughout development (Hoffman, 1978). Recent theories of empathy, however, have introduced multidimensional

[1] In the United States, this book was published under the title, *The Science of Evil: On Empathy and the Origins of Guilt*.

(Davis, 1994) and integrative (Decety & Jackson, 2004; Preston & de Waal, 2002) models that bind several aspects of empathy and empathy-related behaviors. Considering this definition of empathy, it appears that affective empathy is the basis for cognitive empathic ability. Furthermore, it appears that cognitive empathy, as opposed to affective empathy, involves creating a cognitive ToM regarding the other's mental and emotional states.

INVESTIGATING ToM AND EMPATHY CONSTRUCTS

Evidence for the neural bases of multiple dimensions of ToM has come from several sources: functional neuroimaging studies of neurotypical participants, patients with brain injuries or psychopathologies, and children and adolescents with diagnosed developmental disabilities such as autism. Shamay-Tsoory and colleagues have published an extensive set of studies on the neuroanatomical bases of cognitive and affective ToM (e.g., Abu-Akel & Shamay-Tsoory, 2011; Shamay-Tsoory & Aharon-Peretz, 2007; Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010; Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2007).

Considering the contrasts between these two views of ToM, cognitive ToM involves thinking about thoughts, intentions, or beliefs whereas affective ToM involves thinking about feelings. To elicit both aspects in neuroimaging studies, participants may be asked to judge mental or emotional states on the basis of verbal and eye gaze cues of a cartoon figure (e.g., see Shamay-Tsoory & Aharon-Peretz, 2007; Shamay-Tsoory et al., 2010). The task consists of showing a series of cartoon outlines of a face (named "Yoni") and four colored pictures of objects belonging to a single category (e.g., fruits, animals), one in each corner of a computer screen. (One can view the materials at http://sans.haifa.ac.il/Downloads.html.) The participant's task is to point to the image to which Yoni is referring based on a sentence that appears at the top of the screen and available cues, such as Yoni's eye gaze, Yoni's facial expression, or the eye gaze and facial expression of the face to which Yoni is referring. In the cognitive conditions, both Yoni's facial expression and the verbal cue are emotionally neutral, whereas in the affective conditions, both cues provide affective information (i.e., Yoni is thinking of [cognitive condition] vs. Yoni loves [affective condition]). That is, the cognitive condition requires understanding beliefs about the other's beliefs and desires (Yoni is thinking of the toy that ___ wants) whereas the affective condition involves understanding of one's emotions with regard to the other's emotions (Yoni loves the toy that ___ loves). The "Yoni" task has been used in studies of neurological (Shamay-Tsoory et al., 2007) and psychiatric populations (Shamay-Tsoory et al., 2007, 2010), as well as in a recent neuroimaging study (Bodden et al., 2013).

Shamay-Tsoory and colleagues (Shamay-Tsoory et al., 2007; Shamay-Tsoory, Tomer, & Aharon-Peretz, 2005) also have developed a variety of vignettes that require participants to employ cognitive or affective ToM. For example in a vignette involving cognitive sarcasm, Joe goes into the bank manager's office and cannot find anywhere to sit down because all the chairs are occupied with documents and folders. Joe says to the bank manager, "Your office is so tidy!" Participants are asked, "Why did Joe say that? Did Joe think the office was tidy? Was the office tidy?" In a task involving affective sarcasm, a father forgets to pick up his son after school, leaving him in the rain for some time. When the father and son finally get home, the mother says to the father, "You are such a good father." Participants are asked, "Why did mom say that? Did mom think dad was a good father? Was dad a good father on this occasion?"

Other types of tasks for neuroimaging investigations have involved either self-referencing (which can be considered intrapersonal ToM) or other-referencing (which can be considered interpersonal ToM). For example, Jenkins and Mitchell (2011) had participants evaluate adjectives for how they would describe either themselves or the then-current president of the United States. Three different sets of adjectives were assessed, referring to (a) stable personality traits (e.g., in general, how brave?); (b) current mental states (e.g., in the moment, how bored?); and (c) stable physical attributes (e.g., physically, how tall?). Kana, Klein, Klinger, Travers, and Klinger (2013) had high-functioning adults with autism and neurotypical adults make yes–no decision about whether visually presented adjectives (e.g., *smart*, *unhappy*) described themselves (self-judgment) or their favorite teacher (other-judgment). In a similar study, Lombardo et al. (2010) had neurotypical adults make mental reflections about themselves or the Queen of England. On the self-task, participants judged on a scale from 1 (*not at all likely*) to 4 (*very likely*) how likely they would be to agree personally with opinion questions (e.g., "How likely are *You* to think that keeping a diary is important?"). On the other task, the same mentalizing judgments were made, except this time they were in reference to how likely the British Queen would be to agree with opinion questions (e.g., "How likely is the *Queen* to think that keeping a diary is important?").

Behavioral studies not employing functional imaging have shown that performance on interpersonal and intrapersonal ToM tasks can be disassociated—that is, children can perform differently on the two tasks. Lucariello and colleagues (Lucariello, Durand, & Yarnell, 2007; Tine & Lucariello, 2012) compared development of interpersonal and intrapersonal ToM by asking children to respond to vignettes that required cognitive and affective reflections on others or on themselves. For example, for an interpersonal ToM task, children were told a story about Sally/Sam who sees a Band-Aid box. The box is opened and she or he sees that it contains crayons. The children are then asked what Sally/Sam first thought was in the box (cognitive interpersonal ToM) and how Sally/Sam felt about what they thought was in the box (affective intrapersonal ToM). For an intrapersonal ToM task, children are shown a toothpaste box. The box is opened and they discover it is filled with M & Ms. They are then asked what they thought was in the box when they first saw it (intrapersonal cognitive ToM) and how they felt about what they thought was in the box when they first saw it (intrapersonal affective ToM). Performance on these interpersonal and intrapersonal ToM tasks was differentiated in typically developing children and children with autism and Asperger's syndrome.

Empathy is sometimes measured with questionnaires such as the Interpersonal Reactivity Index (Davis, 1983), which measures two types of empathy—affective cognitive and affective empathy. Affective cognitive items involve perspective taking or the ability to transpose oneself into fictional situations. The affective empathy items tap persons' feelings of warmth, compassion, or concern for others or feelings of anxiety or discomfort from tense interpersonal settings. Examples of affective cognitive items are "When I am reading an interesting story or novel I imagine how I would feel if the events in the story were happening to me" or "I try to look at everybody's side of a disagreement before I make a decision." Examples of affective empathy items are "I am often quite touched by things that I see happen" or "When I see someone being taken advantage of, I feel kind of protective toward them."

Studies employing these tasks with functional magnetic resonance imaging and transcranial magnetic stimulation (TMS) have provided evidence that ToM is differentiated into cognitive and affective dimension ToM (thinking about thoughts, intentions, or beliefs vs. thinking about feelings); and each of these dimensions is further differentiated into interpersonal and intrapersonal ToM (thinking about the thoughts and emotions of others vs. reflecting on and regulating one's own thoughts and emotions).

NEUROANATOMICAL EVIDENCE FOR ToM AND EMPATHY DIMENSIONS

Cognitive ToM

Numerous brain regions have been identified as participating in cognitive ToM. These include the medial prefrontal cortex (mPFC), superior temporal sulcus (STS), temporoparietal junction (TPJ), and temporal poles (Frith & Singer, 2008; Saxe & Powell, 2006; Saxe, Whitfield-Gabrieli, & Scholz, Pelphrey, 2009; Schilbach et al., 2012; Van Overwalle & Baetens, 2009; Young, Camprodon, Hauser, Pascual-Leone, & Saxe, 2010). Figure 1 provides a graphic representation of these neuroanatomical regions.

It has been further suggested that the TPJ is mainly in charge of transient mental inferences about other people (e.g., their goals, desires, and beliefs). In support of this conclusion, several studies have found that bilateral TPJ was recruited more when participants listened to stories about character's thoughts or mental states than when listening to descriptions of physical attributes or bodily sensations (Saxe et al., 2009; Saxe & Powell, 2006). Moreover, Young et al. (2010) have shown that a disruption in the functioning of the right TPJ using TMS can result in a reduction of the participant's use of mental state information in moral judgments. The mPFC, on the contrary, supports the attribution of more enduring traits and qualities of others, as well as of the self (Saxe & Powell, 2006; Schilbach et al., 2012; Van Overwalle & Baetens, 2009). Supporting this conclusion, Saxe and Powell (2006) found the mPFC to be activated in both a belief reasoning task and a self-reflection task. Kalbe et al. (2010) reported that cognitive ToM also was impaired by 1-Hz repetitive TMS, which interfered with cortical activity of the dorsolateral prefrontal cortex.

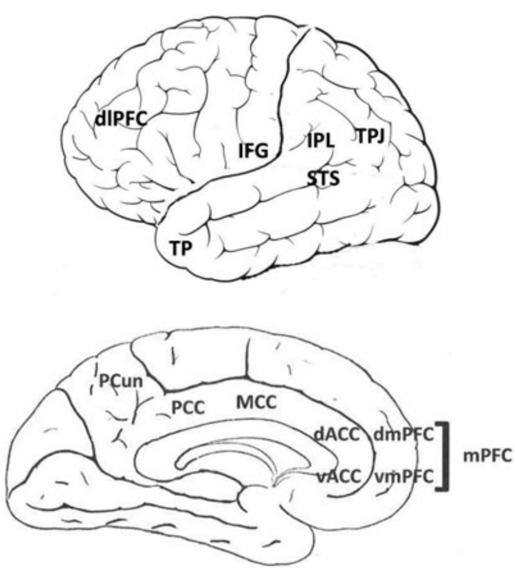

Figure 1. Neuroanatomical areas associated with ToM. Cognitive ToM is associated with the dACC; dorsal lateral prefrontal cortex; dmPFC, superior temporal sulcus, and temporal parietal junction. Affective ToM is associated with the inferior frontal gyrus, orbital frontal cortex, and vmPFC. Intrapersonal ToM is associated with the PCun, PCC, MCC, vmPFC, and vACC. dACC = dorsal anterior cingulate cortex; dmPFC = dorsal medial prefrontal cortex; MCC = middle cingulate cortex; mPFC = medial prefrontal cortex; PCC = posterior cingulate cortex; PCun = precuneus; ToM = theory of mind; vACC = ventral anterior cingulate cortex; vmPFC = ventromedial prefrontal cortex.

Affective ToM and empathy

Studies indicate a neuroanatomical and behavioral dissociation within the mPFC, distinguishing between dorsomedial (dmPFC) and ventromedial (vmPFC) prefrontal cortex areas, with the dmPFC more associated with cognitive and interpersonal ToM and the vmPFC more associated with affective and intrapersonal ToM (Abu-Akel & Shamay-Tsoory, 2011; Choi-Kain & Gunderson, 2008; Kalbe et al., 2010; Shamay-Tsoory & Aharon-Peretz, 2007). Conventionally, lesions in the vmPFC have been associated with impaired affective ToM. These areas are also illustrated in Figure 1.

Neuroanatomical evidence supports two possible empathy systems: an emotional system (i.e., emotional empathy) and a more cognitive system (i.e., cognitive empathy or affective ToM). This model is illustrated in Figure 2. These systems are dissociable and may be activated in different situations. In this model, affective ToM is a more advanced emotional form of mentalizing, rather than what has been called "emotional contagion" (Sebastian et al., 2012; Shamay-Tsoory, 2010, 2011). Affective empathy is suggested to be dependent on the inferior frontal gyrus (IFG),

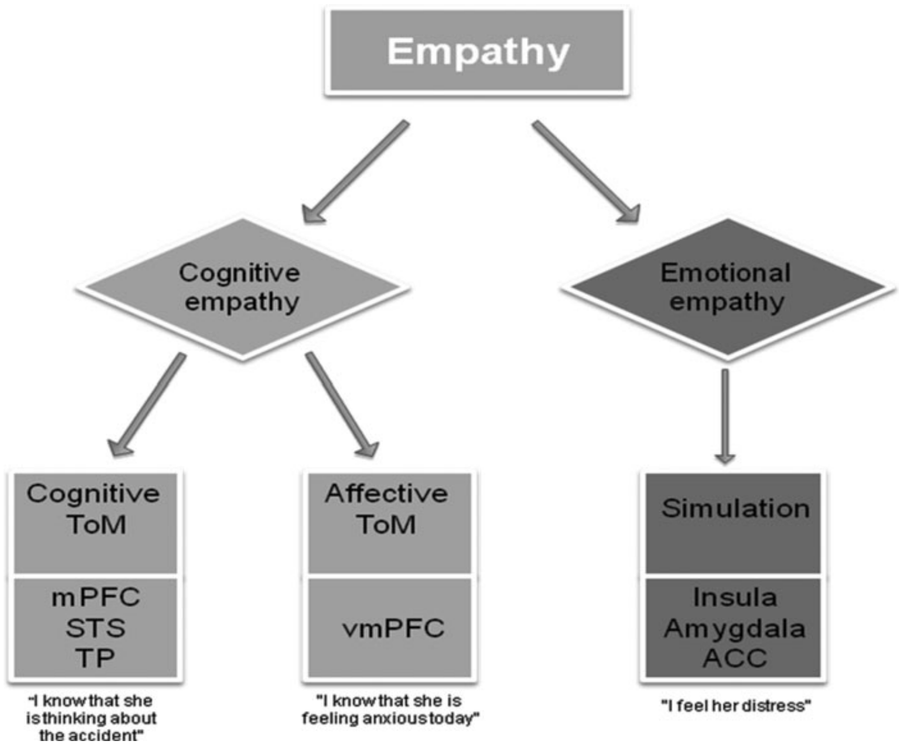

Figure 2. An illustration of the two systems for empathy representing dissociation between cognitive and emotional empathy. A further distinction has been proposed between two types of ToM processes: Cognitive ToM (taking the cognitive perspective of another) and affective ToM (building a theory over what another person feels). ACC = anterior cingulate cortex; mPFC = medial prefrontal cortex; STS = superior temporal sulcus; ToM = theory of mind; TP = temporal parietal; vmPFC = ventromedial prefrontal cortex.

anterior cingulate cortex, amygdala, and insula via the vmPFC. Evidence from lesion studies suggests that individuals with damage to the vmPFC are specifically impaired in affective cognitive ToM (cognitive empathy), whereas patients with lesions in the IFG, insula, amygdala, or anterior cingulate cortex are impaired in affective empathy and emotion recognition (Shamay-Tsoory, Aharon-Peretz, & Perry, 2009).

Interpersonal and intrapersonal ToM and empathy

Imaging studies on self-reflection indicate that cortical midline structures, which are a set of regions in the midline of the cortex arching around the corpus callosum, are involved in intrapersonal ToM activities (self-referential processing). The cortical midline structures (constituting the mPFC, the anterior, middle, and posterior cingulate cortices, and the precuneus) are thought to integrate functionally self-related thought and planning (Northoff et al., 2006; van der Meer, Costafreda, Aleman, & David, 2010).

A distinction between actions generated by the self and those generated by others is one of the elementary prerequisites for mentalizing (Mitchell, 2009). However, whereas emotional empathy requires making a distinction between the self and others, a network involving the vmPFC, and to some extent the TPJ, appears to be responsible for shared representations of self and others during higher level inference-based processes (Zaki, Bolger, & Ochsner, 2009). Therefore, it has been suggested that vmPFC participation in self-reflection redefines this region as a key region necessary for evaluating similarities and differences between one's own mental states and those of others (Mitchell, 2009). It is conceivable that situations involving affective ToM require more self-reflection than situations involving cognitive ToM, which are generally more detached. The vmPFC, which is strongly tied to the amygdala, appears to be particularly important to affective mentalizing rather than to neutral or cognitive forms of mentalizing. In line with this notion, it was suggested in a recent meta-analysis that the vmPFC is more frequently activated by self-related judgments whereas dmPFC is more frequently activated by other-related judgments (Denny, Kober, Wager, & Ochsner, 2012).

Patients with ToM impairments, such as individuals with autism, have been reported to demonstrate impairments in self/other distinction (Kana et al., 2013). Lombardo et al. (2010) found that neurotypical individuals used the vmPFC and the middle cingulate cortex when self-referencing/mentalizing as compared with other-referencing/mentalizing. In contrast, persons with autism used the vmPFC and middle cingulate cortex for both self- and other-referencing. These researchers argued that unusual activation of the vmPFC for other-referencing in addition to self-reflection may explain the mentalizing impairments found in autism.

Further studies have accumulated evidence regarding a dissociation between affective and cognitive ToM in neurological and psychiatric disorders such as Parkinson's disease (Polleti et al., 2012), multiple sclerosis (Roca et al., 2014), schizophrenia (Shur, Shamay-Tsoory, & Levkovitz, 2008), psychopathy (Shamay-Tsoory et al., 2010), and borderline personality disorder (Choi-Kain & Gunderson, 2008; Harari et al., 2010). Taken together, these studies suggest that the vmPFC constitutes a core region within the larger mentalizing network (also pertaining to the mPFC, STS, and temporal poles) that participates in self/other distinctions and in affective ToM. The results of a meta-analysis (van der Meer et al., 2010) have indeed suggested that the connections between the vmPFC and the limbic system underline the region's centrality to emotional self-reflection. To conclude, cognitive empathy appears to be tied to higher order cognitive functions that necessitate self/other distinction and cognitive and affective ToM. The self/other distinction and affective ToM, in turn, involve a broader neural network, the core of which is the vmPFC (and to some extent the TPJ).

EXPLAINING ToM AND AFFECTIVE EMPATHY

Researchers have offered two primary explanations for how persons are able to attribute mental states and emotions to others. The "theory theory" (TT) holds that somehow people acquire a theory of the mental realm. According to this view, people employ ToM to attribute intentional states to other people (Churchland, 1998). Namely, they use cognitive terms to construe situations involving the other, thus constructing a theory by which they understand the object (Premack & Woodruff, 1978). In other words, in line with the TT thesis, people adopt a theoretical stance to gain an understanding of the other's mental state (Gallagher, 2001).

In contrast to the TT explanation of cognitive ToM, the simulation perspective explains that the mental states of others are represented by tracking or matching these states with resonant states of one's own. Employing imagination, mental pretense, or perspective taking, the attributor covertly tries to mimic the mental activity of the target through mirroring processes. For example, if you have run in 10-km race on a hot day, you can put yourself in the place of similar runners and have a sense of what they are thinking and feeling as they run the last kilometer.

Therefore, this perspective emphasizes the use of "shared representations" in empathy. For instance, one's autobiographical memory may contribute to one's ability to simulate the emotions of others. Autobiographical memory, or the ability to recall one's specific past experiences, differs from semantic memory, which is simply knowledge of facts and concepts. Autobiographical memory requires the ability to project oneself through time and hence requires self-mentalizing or intrapersonal ToM. There is growing evidence that remembering the past and the ability to mentalize about others share an extensive functional neuroanatomy, implying that these processes share analogous mechanism (Mitchell, 2009; Rabin, Gilboa, Stuss, Mar, & Rosenbaum, 2010; Spreng & Mar, 2012). On the basis of a meta-analysis of neuroimaging studies, van der Meer et al. (2010) suggested that while the vmPFC is responsible for emotional self-reflection, a network that includes the mPFC and medial temporal lobes is responsible for integrating self-referential representation (intrapersonal ToM) and autobiographical memory. Although there are conflicting reports on the role of autobiographical memory in mentalizing about others (or simulating the experience of others), persons are more likely to use autobiographic information (use simulation) when they perceive others as more similar to themselves than different from themselves (Perry, Hendler, & Shamay-Tsoory, 2011).

It has been further suggested that the affective aspect of empathy also includes an "experience sharing" component that is more automatic and implicit (Keysers, Kaas, & Gazzola, 2010). The identification of a class of neurons in the primate premotor cortex, known as mirror neurons, has provided some clues as to how this mechanism works and has greatly reinforced the simulation perspective. Mirror neurons were first discovered in the premotor cortex of macaque monkeys. These are neurons that fire as the monkey performs object-directed actions such as grasping, tearing, manipulating, and holding, yet they also fire when the animal observes another animal or human being performing similar actions. Mirror properties were found in human subjects with inferior frontal and posterior parietal cortical involvement (Iacoboni et al., 2005). In the context of social cognition, it has been proposed that mirror neurons may provide a neural mechanism for recognizing the observed motor acts (e.g., grasping, holding, bringing to the mouth) as well as a mechanism for understanding the intentions of others (Avenanti, & Urgesi, 2013; Iacoboni, 2009; Iacoboni et al., 2005; Pfeifer et al., 2009; Rizzolatti & Craighero, 2004; Waytz & Mitchell, 2011).

Mirror neurons are thus active both during the execution and observation of an action. It has been suggested that, given the observation-execution properties of the mirror neuron system, it is particularly well suited for providing the pertinent mechanism for motor empathy, imitation, and emotional contagion.

A "mirror-like" activity has been identified in humans in the IFG and in the inferior parietal lobule. The IFG has been suggested as being capable of recognizing the aims or intentions of actions through their resemblance to stored representations of these actions (Avenanti & Urgesi, 2011; Enticott et al., 2012; Rizzolatti, Fabbri-Destro, & Cattaneo, 2009; also see Hickok, 2009 for a critical review of the mirror neuron theory in humans). Consistent and strong evidence exists for IFG participation in emotional contagion and emotion recognition. Indeed, further support for simulation-like activity in humans has also been found in studies examining various basic and complex emotions (Benuzzi, Lui, Duzzi, Nichelli, & Porro, 2008; Blakemore, Bristow, Bird, Frith, & Ward, 2005; Ebisch et al., 2008; Jabbi, Swart, & Keysers, 2007; Krach et al., 2011; Masten, Morelli, & Eisenberger, 2011; Mobbs et al., 2009; Morrison, Lloyd, di Pellegrino, & Roberts, 2004; Prehn-Kristensen et al., 2009; Singer et al., 2004; Singer, 2006; Wicker et al., 2003). Furthermore, overt facial mimicry (as measured by electromyography or through observation) has been shown to be related to emotional contagion and emotion understanding (Niedenthal, 2007). Mirror-like activity in the human IFG, which is related to emotional facial expressions, may imply that these regions may be deployed to transform observed facial expressions into a pattern of neural activity that would be appropriate for generating similar facial expressions and could constitute the neural basis for emotional contagion (Keysers & Gazzola, 2006). Moreover, some neuroimaging studies centered on emotion recognition and empathizing with people who are subject to serious threat or severe harm, further substantiating the particular role of the IFG in emotional empathy (Nummenmaa, Hirvonen, Parkkola, & Hietanen, 2008; Schulte-Ruther, Markowitsch, Fink, & Piefke, 2007).

Emotional empathy, through simulation processes, also includes motor and perceptual components. Various studies have shown that watching someone else in pain or being touched triggers an internal sensorimotor simulation of the observed somatic experience in the observer (e.g., Avenanti, Bueti, Galati, & Aglioti, 2005; Bufalari, Aprile, Avenanti, Di, & Aglioti, 2007; Keysers et al., 2004). This sensorimotor resonant mechanism, mediated by somatomor cortices (such as SI, SII, motor and premotor cortices, etc.) was found critical for understanding other's emotions (Adolphs, Damasio, Tranel, Cooper, & Damasio, 2000; Borgomaneri, Gazzola, & Avenanti, 2014; Pitcher, Garrido, Walsh, & Duchaine, 2008). The activity in these cortices was also found to correlate with psychological factors (suggested in behavioral studies to affect the degree of empathy), such as personality traits of the empathizer (Avenanti, Minio-Paluello, Bufalari, & Aglioti, 2009; Schaefer et al., 2013) and the attitude toward the target's social membership (Avenanti, Sirigu, & Aglioti, 2010), with the possibility to predict prosocial behavior in real-life situations (Ma, Wang, & Han, 2011).

It should be noted that the role of mirror neurons in simulation has been challenged (Hickok, 2009). Mirror neurons, however, would not have to explain all simulations. Walter (2012) suggests a low road and a high road to empathy. Mirror neurons are hypothesized to function in the low road, responding more or less automatically to facial expressions and body movements. They could account for emotional contagion. In a high road to empathy, empathic processes are induced top-down by higher cognitive processes, which might be inferences or thoughts based on logical relations or contextual and situational information or simulation triggered by autobiographical memories. It is possible that under normal circumstances, every interaction with a protagonist may independently trigger both an emotional response (emotional empathy) and a cognitive evaluation of the individual's state of mind and point of view (cognitive empathy; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). In the past few years, data from naturalistic models point to the suggestion that in complex social situations individuals use multiple empathic processes rather than distinct, depending on the context and relevance to social goals and cues (Zaki & Ochsner, 2012). Hence, although both the emotional and cognitive components of empathy may work autonomously, in natural social situations, every empathic response evokes both types of components to some extent (Zaki & Ochsner, 2012), depending on variables such as the social context (Harris & Fiske, 2006), the level of distress (Jackson, Brunet, Meltzoff, & Decety, 2006), or the perceived similarity between the individual and the protagonist (Hein, Silani, Preuschoff, Batson, & Singer, 2010; Mitchell et al., 2005).

In conclusion, although the simulation perspective may be more suitable in explaining emotional empathic processing, TT processes may underlie cognitive empathy. Therefore, decreased empathic response may be due to deficits in mentalizing (cognitive ToM, affective ToM) or in simulation processing (emotional empathy), with these deficits mediated by different neural systems. One central hypothesis is that simulation processing underlies emotional empathy whereas ToM underlies the cognitive empathic response. These processes are served by separate, albeit interacting, brain networks. When a cognitive empathic response is generated, the ToM network (i.e., mPFC, STS, temporal poles) and the affective ToM network (mainly involving the vmPFC) are typically involved. In contrast, the emotional empathic response is driven mainly by simulation and involves regions that mediate emotional experiences (i.e., amygdala, insula). We can assume that balanced activation of these two networks is required for appropriate social behavior.

IMPLICATIONS

Theory of mind deficits are considered to be at the heart of the social difficulties exhibited by persons with autism and Asperger's syndrome and are common in children and adolescents who are deaf or hard of hearing (Kimhi, 2014; Stanzione & Schick, 2014) and have been associated with the social problems exhibited by persons with brain injuries, degenerative neurological conditions, and psychiatric diagnoses. Assessments and interventions for persons with ToM deficits have focused typically on assessing and developing interpersonal cognitive ToM as a way to improve social skills. Results of neuroscience studies, however, indicate that ToM is a multidimensional rather than a unitary construct and that possessing knowledge of the thoughts and feelings of others does not ensure empathy for others.

Although dissociations can be made between several empathic processes, these processes work together in naturalistic situations. As the work on the neural underpinnings of ToM and empathy reviewed in this article shows, interventions addressing cognitive ToM may improve a person's understanding of others' thoughts and behaviors; however, they are unlikely to have much effect on affective ToM and affective empathy. Consequently, professionals providing clinical services to children, adolescents, and adults with ToM deficits should develop ToM profiles for their clients that are comprehensive. Westby and Robinson (2014), for example, provide a framework for assessing and intervening in these multiple aspects of ToM. This includes documenting strengths and deficits along all ToM dimensions—interpersonal and intrapersonal cognitive and affective ToM and affective empathy. Then, clinicians can design interventions to target the specific deficits.

Finally, an intervention that aims to improve clinical indices of social dysfunction needs to take into account the complex relations between empathic processes. Although existing studies have identified variables affecting cognitive and affective empathy, less is known about the relations between these processes. As interventions are designed to affect performance in complex situations and not just simplified ToM tasks, studies should focus on naturalistic approaches using ecologically valid tools that simulate real-life situations. It is such tools that will illuminate empathic processes that enhance how humans interact.

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