



Empathy: Gender effects in brain and behavior



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ABSTRACT

Evidence suggests that there are differences in the capacity for empathy between males and females. However, how deep do these differences go? Stereotypically, females are portrayed as more nurturing and empathetic, while males are portrayed as less emotional and more cognitive. Some authors suggest that observed gender differences might be largely due to cultural expectations about gender roles. However, empathy has both evolutionary and developmental precursors, and can be studied using implicit measures, aspects that can help elucidate the respective roles of culture and biology. This article reviews evidence from ethology, social psychology, economics, and neuroscience to show that there are fundamental differences in implicit measures of empathy, with parallels in development and evolution. Studies in nonhuman animals and younger human populations (infants/children) offer converging evidence that sex differences in empathy have phylogenetic and ontogenetic roots in biology and are not merely cultural byproducts driven by socialization. We review how these differences may have arisen in response to males' and females' different roles throughout evolution. Examinations of the neurobiological underpinnings of empathy reveal important quantitative gender differences in the basic networks involved in affective and cognitive forms of empathy, as well as a qualitative divergence between the sexes in how emotional information is integrated to support decision making processes. Finally, the study of gender differences in empathy can be improved by designing studies with greater statistical power and considering variables implicit in gender (e.g., sexual preference, prenatal hormone exposure). These improvements may also help uncover the nature of neurodevelopmental and psychiatric disorders in which one sex is more vulnerable to compromised social competence associated with impaired empathy.

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1. Introduction

Empathy – the ability to understand and share in the internal states of others – is a complex, multidimensional phenomenon that includes a number of functional processes, including emotion recognition, emotional contagion, and emotion priming (for recent reviews, see Decety and Jackson, 2006; Singer, 2006; Walter, 2012), as well as the abilities to react to the internal states of others, and to distinguish between one's own and others' internal states (e.g., Tomova et al., 2014). From the perspective of evolutionary and developmental biology, empathy's purposes, in both humans and nonhuman animals, can be broadly divided into two categories: *Promoting prosocial, cooperative behavior, and understanding or predicting the behavior of others* (Smith, 2006).

Empathy has been studied from many perspectives (Davis, 1980; Decety and Moriguchi, 2007; Zaki and Ochsner, 2012). For example, social psychology has examined the manifestations of empathy within moral reasoning and social behaviors like mimicry (e.g., Sonnby-Borgström, 2002). In economics, studies have considered empathy's effects on decision-making (e.g., Beadle et al., 2012; Loewenstein, 2005; Ferrari, 2014). Cognitive neuroscience studies of empathy, on the other hand, are mainly divided into two lines of research, one focused on preconscious mechanisms which underlie/facilitate sharing (and mimicry) of others' behaviors and internal states (we will refer to it as *mirroring*); the other line of research is focused on a conscious, deliberative process through which inferences can be made about others' bodily and affective states, beliefs, and intentions (often called *mentalizing*) (Keysers and Fadiga, 2008; Zaki and Ochsner, 2012). These two aspects of empathy can be roughly mapped onto *affective* (or pre-reflective) and *cognitive* (reflective) empathic predispositions, respectively (Smith, 2006). Affective empathy is associated with activity in frontoparietal, temporal, and subcortical regions classically associated with movement, sensation, and emotion, while neural systems involved in cognitive control and decision-making – such as the cingulate, prefrontal, and temporal areas – are often activated during tasks requiring cognitive empathy (see Fig. 1) (Zaki and Ochsner, 2012).

How are these two primary modes of empathizing – cognitive empathy and affective empathy – related? While affective empathy involves pre-reflective processes, humans seem nevertheless capable of consciously and unconsciously modulating it. Furthermore, humans are capable of internally evoking emotions,

behaviors, and sensations of an absent other, or even of ourselves at another point in time. We are also capable of inhibiting our internal states and reflexive responses to others. Indeed, numerous studies have shown that mirroring is modulated by numerous contextual factors, such as social distance, status, trustworthiness, group membership, and attention (Bernhardt and Singer, 2012; Gu and Han, 2007; Guo et al., 2012; Hogeveen et al., 2014; Lamm et al., 2007; Liew et al., 2011; Loggia et al., 2008; Singer et al., 2006), and is controlled by systems involved in cognitive empathy (Spengler et al., 2010). Conversely, some authors propose that mentalizing and social decision-making may employ information derived from mirroring (Iacoboni et al., 2005; Obhi, 2012; Zaki and Ochsner, 2009) (Fig. 2).

Recent studies suggest that a large portion of the ability to read intentions derive from pre-reflective mechanisms for processing biological motion (Obhi, 2012), and studies of empathic accuracy have shown that accurately discerning the internal states of others, as well as inferring intentions from observed behavior, relies on the interaction between mirroring and mentalizing processes (Liew et al., 2011; Zaki and Ochsner, 2012). There is also evidence that our immediate affective responses to others' pain and distress can increase prosocial decision-making (Christov-Moore and Iacoboni, under revision; Hein et al., 2010; Masten et al., 2011; Ma et al., 2011; Smith, 2006). Indeed, it is likely that, without the interactive participation of both modes of empathizing, social interactions would be impaired, potentially impacting the health and wellbeing of the individual as well as those around him/her (Gallese, 2003).

While we now associate the mentalizing system with decision-making, musing about others etc., this system may have arisen in part as a form of contextual control for mirroring. In our view, this seems likely for two reasons: compared to the mirroring system, both the mentalizing system's cognitive functions and the brain areas that underlie mentalizing (i.e., temporal and prefrontal cortices), (1) developed more recently in our evolution and (2) are the last to mature during ontogeny (Preston and De Waal, 2002). Furthermore, neural systems associated with mentalizing have been implicated in the control of behavioral mirroring (mimicry) (Spengler et al., 2010). Indeed, recent evidence from our group (Christov-Moore and Iacoboni, under revision) suggests that *mirroring areas and mentalizing areas exist in interaction rather than as independent systems*. Rather than just using the mirroring system when we view others in pain, feeling emotion, or having fast social interactions that are typically thought to bypass mentalizing

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