

Promises and Challenges of the Neurobiological Approach to Empathy

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Abstract

Empathy is a complex social cognitive construct. Its scientific investigation requires both a careful analysis of the concepts used as well as a multilevel integrative analysis, including studies with atypical populations, not just neuroimaging data in healthy participants. Further, the fact that the experience of empathy involves both intrapersonal and interpersonal emotional states poses a challenge to neuroscientific investigations.

Keywords

affective arousal, empathic concern, empathy, neuroscience

Empathy is not unique to humans, as many of its physiological mechanisms are shared with other mammalian species. The selection pressure to evolve rapid emotional connectedness likely began in the context of parental care long before our species appeared. Recognizing, evaluating, and responding to newborns' and infants' signals of distress is of primary importance to parental care for offspring survival and fitness. Thus, while I agree with Joan Chiao (2011) that cultural neuroscience will contribute to our understanding of how cultural and genetic factors shape the experience of empathy and prosocial behavior, I primarily see empathy as an adaptive behavior shared by all healthy individuals—across all cultures—which evolved under pressures from kin selection as well as group selection. The role of specific genes in empathy and prosocial behavior is a fascinating avenue. It will be crucial, however, to identify which aspects of empathy are associated with specific genetics factors, as well as to be careful not to rely (only) on self-reports' dispositional measures whose validity and reliability are questionable.

Raymond Mar (2011) reminds us that empathy unfolds over time, and that current neuroimaging techniques cannot adequately inform us about the time course in subcortical structures. Neuroimaging represents only a part of the armamentarium that is needed to study the mechanisms underlying the experience of empathy, and the extent of the findings provided by such techniques are indeed quite limited. This is not only due to the

poor temporal resolution of the hemodynamic signal for functional magnetic resonance imaging (fMRI) or the poor spatial resolution of electroencephalographic (EEG, event related potentials [ERPs]) techniques. The reality is that the constraints of MRI scanning and ERPs measures are so severe that most of the studies can only inform us about the first seconds of the neural response to empathy-evoking stimuli. In addition, given the poor signal to noise ratio, MRI and EEG data are integrated across huge numbers of trials, while we would like psychological process data to describe and explain on-line second-to-second processing of input as well as the “thinking” that gets carried out in reaction to one event, not several events. An illustrative example is the impressive number of fMRI studies of empathy for pain that shows the activation of the same regions (insula and anterior cingulate cortex) that are commonly interpreted as *the* neural basis of empathy. In fact this circuit may be best described as the neural response (including the awareness) to aversive stimuli, and certainly cannot account for the complexity of the empathy construct. Importantly, it is not clear how the motivational component of empathy (being concerned by the affective state of the other) is associated with such a neural response.

It should not come as a surprise that empathy is implemented by a network of distributed, often recursively connected interacting neural regions and systems. Converging evidence from animal behavior, functional imaging studies in normal individuals, and lesion studies in neurological patients shows that empathy draws on a large array of brain structures and systems which are not limited to the cortex, but also, subcortical nuclei, autonomic nervous system, hypothalamic-pituitary-adrenal axis, and endocrine systems that regulate bodily states, emotion, and reactivity. Furthermore, caring for others (empathic concern) draws on general mammalian neural systems of reward, social attachment, and aversion (Moll et al., 2007). Thus I could not agree more with Raymond Mar when he states that conventional fMRI does not provide us with the temporal resolution to examine the respective contribution of bottom-up and top-down processes that contribute to the

experience of empathy. The development and application of neuroimaging methods offers a powerful means to study brain functions related to emotion processing and empathy, but the resulting knowledge is more likely to be beneficial when combined with conceptual analyses that decompose the complex psychological construct of empathy into component structures, representations, processes, and computations; converging measures that gauge neural events at different temporal and spatial scales; behavioral measures that allow for fine-grain analyses of brain–behavior associations; and experimental (e.g., lesion, transcranial magnetic stimulation) and nonhuman animal studies that test the putative role of specific brain structures, circuits, or processes (Decety & Cacioppo, in press).

James Blair (2011) argues against the idea that the affective arousal component of empathy is underpinned by the perception–action mechanism, and proposes instead that this component is based on conditioning. In recent years, most of the neuroimaging evidence has been inconsiderately interpreted in line with the mirror neurons account, which basically boils down to sensorimotor resonance between a target and an observer. I appreciate and share James’ reservations about this mechanism being the physiological substrate of affective arousal. As a matter of fact, James’ comment made me reappraise this aspect of the model which was not totally clear in the paper. The following results of a recent ERPs study provide strong support in favor of James Blair’s proposal. Empathy dysfunction is one of the core

characteristics in youth with callous-unemotional traits. Cheng, Hung, and Decety (in press) found that incarcerated juvenile psychopaths who scored high on callous-unemotional traits, compared to incarcerated participants with low callous-unemotional traits, exhibited a reduced frontal N120 (measured with ERPs) in response to visual stimuli depicting people in pain, indicating an absence of early affective arousal. However, there was no deficit in sensorimotor resonance in both groups, as assessed by measures of the *mu* suppression over the sensorimotor cortex, which is considered as a reliable index of the mirror neuron system. This finding suggests that affective arousal is not mediated by the mirror neurons system.

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