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Neural correlates of feeling sympathy

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Abstract

Positron emission tomography (PET) was used to investigate the neural correlates of feeling sympathy for someone else (i.e. the affinity, association, or relationship between persons wherein whatever affects one similarly affects the other). While undergoing PET scans, subjects were presented with a series of video-clips showing individuals (who were semi-professional stage actors) telling sad and neutral stories, as if they had personally experienced them. These stories were told with either congruent or incongruent motor expression of emotion (MEE). At the end of each movie, subjects were asked to rate the mood of the communicator and also how likable they found that person. Watching sad stories versus neutral stories was associated with increased activity in emotion processing-related structures, as well as in a set of cortical areas that belong to a "shared representation" network, including the right inferior parietal cortex. Motor expression of emotion, regardless of the narrative content of the stories, resulted in a specific regional cerebral blood flow (rCBF) increase in the left inferior frontal gyrus. The condition of mismatch between the narrative content of the stories and the motor expression of emotion elicited a significant skin conductance response and strong rCBF increase in the ventromedial prefrontal cortex and superior frontal gyrus which are involved in dealing with social conflict. Taken together, these results are consistent with a model of feeling sympathy that relies on both the shared representation and the affective networks. Interestingly, this network was not activated when subjects watched inappropriate social behavior.

Keywords: Sympathy; Empathy; Intersubjectivity; Shared representations; Neuroimaging

1. Introduction

Many philosophers and psychologists have proposed that prosocial behavior is often motivated by sympathy or empathy. For instance, in his *Treatise of Human Nature* (1739/1888), Hume [52], observed that our minds are mirror to one another: they reflect one another's passions, sentiments, and opinions. This "sympathy" or "propensity we have to sympathize with others, to receive by communication [the] inclinations and sentiments [of others], however different from, or even contrary to, our own," he held to be the chief source of moral distinctions. For his colleague Smith [79], sympathy is our ability to feel with other persons and it is a universal feature of human nature.

This conception of sympathy, dating from the time of the *Enlightenment*, is well supported today by a mass of converging evidence from developmental psychology and cognitive neuroscience. It should be noted, however, that there are many definitions of sympathy and empathy, almost as many as there are researchers who study the topic (e.g. [9,20–59,80]).[1] Notably, Wispé [86] described empathy as an effortful process by which we try to comprehend another's experience, while sympathy would be a direct perceptual awareness of another person's experience akin to the phenomenon of sympathetic resonance. Yet most scholars would agree that the two concepts partly overlap and that sympathy is an affective response that frequently stems from empathy and consists of feelings of concern for the distressed or needy other person, rather than feeling the same emotion as the other person, which is closer to empathy [69]. In the present study, sympathy is taken in one of its ordinary usages, especially in French-speaking countries, i.e. the affinity, association, or relationship between persons or things wherein whatever affects one similarly affects the other. Our definition is a combination of empathy and sympathy, and reflects at a common sense level how we may in everyday life automatically interrelate with other people. Such a definition is also close to what Hodges and Wegner

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[1] Levy suggests that "the word" empathy "be deleted from the technical language of psychology and replaced by a less ambiguous word or words" [57].

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[48] define as automatic empathy as opposed to controlled empathy and to what Nichols characterizes as a “concern mechanism” [66], which is considered to depend on a minimal capacity for mind-reading and also on the affective system.

It has been shown that very young infants express what Trevarthen [83] terms intersubjective sympathy, i.e. they are predisposed to be sensitive and responsive to the subjective states of other persons. This can be demonstrated through several means, including the spontaneous face-to-face interaction between infants and their mothers and through more specialized “still-face procedures” (i.e. when mothers adopt a neutral face and stop responding to the infant), which leads to withdrawal by the infant. Developmental studies have also shown that the newborns can imitate various body movements performed by adults, for example mouth opening, tongue protrusion, lip pursing, finger movements, and also emotional expressions [64,71]. It has been hypothesized that infant imitation depends on the recognition that the other is a psychological agent like oneself [7], what Meltzoff and Moore have termed a “like-me mechanism” [62]. Other research suggests that early on infants develop a sense of themselves as agents capable of causing changes in the physical environment, as well as communicative and reciprocating social agents [73]. These findings have led Gallagher and Meltzoff [34] to propose that the understanding of the other person is primarily a form of embodied practice. The initial connection between self and other, so-called primary intersubjectivity, may be the foundation for developmentally more sophisticated accomplishments, such as the perception of dispositions and intentions in other individuals [64,73].

Sympathy and empathy may be viewed as other-oriented moral sentiments that may trigger altruistic desires [6,66,80]. This may be because an overt motivation for prosocial behavior is triggered when the self covertly (and automatically) resonates with the other, to use the metaphor of resonance that Gibson [37] and then Shepard [78] expressed.[2] Such resonance is probably neurologically hard-wired, as developmental research suggests, but it is most likely a distributed neural mechanism. Moreover, this resonance phenomenon is consistent with the notion of “shared representations”, which postulates that perception and action share common cognitive and neural codes [8,12,42,50,54]. According to this model, perception of a given behavior in another individual automatically activates one’s own representations for the behavior [24]. Such a model is similar to the so-called simulation theory [46].[3] Evidence for this model derives from neurophysiological investigations [27,28], as well as from several functional imaging studies that have shown similar patterns of neurodynamic activity in the premotor and in the posterior parietal cortices when subjects observe actions performed by another individual and when they actually perform or mentally simulate the same actions [11–13,21,22,40,41,75]. One other neuroimaging study [10] has even demonstrated somatosensory activation in a somatotopic manner in the premotor cortex during action observation. Electrophysiological measurements have also shown that when subjects observe hand movements, there is a desynchronization over the motor cortex similar to which occurs during actual movements [14,44]. Further evidence for the neural substrate of shared representations has recently been provided by neuroimaging studies of imitation in humans [11,13,21,53]. Importantly, these studies have consistently pointed out the crucial role of the parietal cortex not only when the self resonates with the other, but also in distinguishing the self from the other.

Contemporary cognitive neuroscience has also made considerable progress in understanding the anatomical organization of emotional processing [3,56] and points to the role of several neural circuits such as the amygdala and the adjacent cortices, the orbitofrontal cortex, and the insula. Interestingly, it has recently been discovered that patients with right hemisphere lesions in the somatosensory-related cortex are impaired in the recognition of emotion [4]. This finding has led Adolphs and colleagues to suggest that to recognize another’s display of emotion, individuals covertly reconstruct an on-line somatosensory representation. This suggestion parallels the shared representations account of our ability to make sense of the behavior of others [8,42,54], which to some extent, overlaps simulation theory of the philosophers of mind, which says that we use our cognitive capacities to simulate and pretend to be in the situation of others [38,39,45].

We suggest that sympathy, which involves the affective experience of another person’s actual or inferred emotion, can be tackled using the “shared representations” model. We are aware that sympathy is a complex construct that involves a variety of different cognitive and emotional processes. In the present experiment, we tested whether, as the shared representations model postulates, brain regions involved in feeling

[2] The concept of resonance requires both parallel processing, a radically modern idea in Gibson’s time, and a group of mechanisms with which to resonate. Later, Shepard [78] proposed that, as a result of biological evolution and individual learning, the organism is, at any given moment, tuned to resonate to the incoming patterns that correspond to the invariants that are significant for it. Interestingly, Shepard [78] proposed that the external constraints that have been most invariant throughout evolution have become most deeply internalized, and even in the complete absence of external information, the system can be excited entirely from within (while dreaming, for example). Thus, unlike Gibson, Shepard makes explicit reference to internal representation and, to our opinion, makes possible to articulate the notion of resonance with that of shared representations.

[3] The simulation theory developed by Hesslow [46] is based on three assumptions about brain function: (1) behavior can be simulated by activating motor structures, as during an overt action but suppressing its execution; (2) perception can be simulated by internal activation of sensory cortex, as during normal perception of external stimuli; (3) both overt and covert actions can elicit perceptual simulation of their normal consequences. In the domain of emotion processing, Adolphs considers the simulation hypothesis as a plausible mechanism for recognizing emotion from faces [5].