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On the interaction of social affect and cognition: empathy, compassion and theory of mind

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Empathy, compassion and Theory of Mind (ToM) are central topics in social psychology and neuroscience. While empathy enables the sharing of others' emotions and may result in empathic distress, a maladaptive form of empathic resonance, or compassion, a feeling of warmth and concern for others, ToM provides cognitive understanding of someone else's thoughts or intentions. These socio-affective and socio-cognitive routes to understanding others are subserved by separable, independent brain networks. Nonetheless they are jointly required in many complex social situations. A process that is critical for both, empathy and ToM, is self-other distinction, which is implemented in different temporoparietal brain regions. Thus, adaptive social behavior is a result of dynamic interplay of socio-affective and socio-cognitive processes.

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As a social species, humans are continuously required to process complex social signals. Successful multifaceted social interactions are enabled by socio-affective and socio-cognitive capacities such as empathy, compassion and Theory of Mind (ToM). In this review we will first define these social functions and describe the neural networks associated with each of them. Further, we discuss the interaction of empathy and ToM and delineate the importance of one crucial process, that is, self-other distinction. Socio-affective and socio-cognitive processes are also essential for how (prosocially) we interact with others, particularly when faced with others' suffering. Two possible outcomes of empathic sharing of others' suffering are empathic distress on the one hand, which may be detrimental to the observer and to others and compassion, on the other hand, which is a feeling of warmth and concern for the other. We conclude with a concise summary and an opinion statement.

Defining and neurally characterizing empathy, compassion and Theory of Mind

Empathy describes the process of sharing feelings, that is, resonating with someone else's feelings, regardless of valence (positive/negative), but with the explicit knowledge that the other person is the origin of this emotion [1]. This socio-affective process results from neural network activations that resemble those activations observed when the same emotion is experienced first-hand (shared network hypothesis) [2–5]. The first studies in neuroscience targeting empathy investigated empathy in the domain of pain, showing that directly experiencing pain and witnessing another person receiving painful stimuli results in shared neural activations in the anterior insula (AI) and anterior middle cingulate cortex (aMCC) [6,7]. Meta-analyses have later identified these regions as a core network that is activated whenever we witness the suffering of others [8,9]. Furthermore, this network is modulated by individual differences in experienced negative affect and empathy [6,10]. While empathy refers to an isomorphic representation of someone else's affective state, compassion is a complementary social emotion elicited by witnessing the suffering of others and is rather associated with feelings of concern and warmth, linked to the motivation to help [2,11]. Empathy and compassion also differ on a neural level: compassion activates networks that have previously been associated with reward and affiliation processes including the ventral striatum (VS), the nucleus accumbens, the ventral tegmental area (VTA), the medial orbitofrontal cortex (mOFC) and the subgenual anterior cingulate (sgACC) [12,13,14•,15,16•,17]. Congruently with these activations in reward-associated and affiliation-associated networks, compassion generates positive affect towards others' suffering. In contrast to compassion, empathic distress, which is an alternative outcome of empathy, may be detrimental to the experiencer as well as to the suffering other [15,18].

In contrast to socio-affective processes, socio-cognition refers to taking another person's perspective (also referred to as ToM, mentalizing, or cognitive empathy). Rather than an emotional state, ToM yields abstract, propositional knowledge about the other's mental state. It describes the process of inferring and reasoning about

the beliefs, thoughts or emotions of others [19–22]. Crucial brain regions involved in ToM include the ventral temporoparietal junction (TPJ), superior temporal sulcus (STS), temporal poles (TP), medial prefrontal cortex (MPFC) and precuneus/posterior cingulate (PCC) [23].

Interactions of social affect and social cognition

Both socio-affective and socio-cognitive processes have been extensively investigated [6,8,9,23,24]. However, research has only recently begun to study how these processes are related and work together to achieve adaptive social behavior. Making use of a novel task (EmpaToM) [25••] that stimulates both functions concurrently (see Figure 1), the respective neural correlates can be directly compared. The EmpaToM clearly activates separable brain networks that can be replicated in resting state functional connectivity [25••] and on a brain structural level [26•]. Crucially, individual differences in empathy and ToM are unrelated on a behavioral and neural level, that is, strong empathizers are not necessarily proficient mentalizers [27•]. In line with such independent functions, selective impairments in empathy or ToM have been observed in different psychopathologies such as autism and psychopathy. In autism, ToM is deficient [28–31], while no empathy deficits are observed when controlling for alexithymia [32–35]. In psychopathy or chronic aggression, in contrast, ToM is intact, but the propensity to empathize with others is reduced [36,37].

Despite being separable, empathy and ToM are jointly required in many complex social situations. An indirect source of evidence for such co-activation is a meta-analysis on different empathy for pain paradigms, which suggests that the core region of the ToM network is co-activated in empathy paradigms when additional inferring from a cue is required to understand the other's state. [8]. The paradigms investigated in this meta-analysis varied depending on the information provided to the participants. In picture-based paradigms, they were presented with visual depictions of someone in a painful situation,

Figure 1

The EmpaToM task. This figure presents the experimental set-up of the EmpaToM task (previously published here [25••]). The design is a 2 (emotionality of video) × 2 (ToM requirements) design, resulting in four different video types. Each actor presented each video type: emotional negative and neutral videos, as well as videos with ToM requirements or factual reasoning demands. Each video was followed by various ratings, a valence rating (ranging from negative to positive) and a compassion rating (ranging from none to very much compassion they felt for the person in the video. Afterwards they answered a question that either probed for ToM or factual reasoning. After each question, participants were asked how confident they felt about their answer. For further information on this task, please refer to Kanske *et al.* [25••].