Attention to the other's body sensations modulates the ventromedial prefrontal cortex

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Abstract

Theory of Mind (ToM) is involved in experiencing the mental states and/or emotions of others. A further distinction can be drawn between emotion and perception/sensation. We investigated the mechanisms engaged when participants' attention is driven toward specific states. Accordingly, 21 right-handed healthy individuals performed a modified ToM task in which they reflected about someone's emotion or someone's body sensation, while they were in a functional magnetic resonance imaging scanner. The analysis of brain activity evoked by this task suggests that the two conditions engage a widespread common network previously found involved in affective ToM (temporo-parietal junction (TPJ), parietal cortex, dorso-lateral prefrontal cortex (DLPFC), medial- prefrontal cortex (MPFC), Insula). Critically, the key brain result is that body sensation implicates selectively ventromedial prefrontal cortex (VMPFC). The current findings suggest that only paying attention to the other's body sensations modulates a self-related representation (VMPFC).

Key words: ToM; fMRI; emotion; perception; VMPFC

Introduction

Theory of Mind (ToM) is the ability to understand other people by ascribing mental states, beliefs, emotions and intentions to them (e.g. Premack and Woodruff, 1978). Several theories of ToM have been put forward to date (Baron-Cohen, 2001). Among them, the Simulation Theory (Gallese and Goldman, 1998; Ramnani and Miall, 2004) holds that self-representations, awareness and agency are cognitive components of ToM, while the temporoparietal area and the prefrontal cortex have been indicated as the neural correlates of self-other representations and agency (e.g. Decety and Grèzes, 2006). According to this theory, we can 'read' ToM states by imagining, through mental simulation, the same beliefs, states, emotions and intentions of others (e.g. Decety and Grèzes, 2006). A significant portion of ToM, however, is not simulation-based but theory-based: as individuals might employ stereotypes about the behavior/experience of a character described as being of a different gender/group, the inference about others is not based on a simulation.

ToM is multidimensional and includes a cognitive ToM, which corresponds to the knowledge about beliefs of the other, and an affective ToM, which corresponds to knowledge about emotions, through empathic appreciation of the observed person's emotional state (e.g. Shamay-Tsoory and Aharon-Peretz, 2007b).

Although many studies focused on the difference between Cognitive and Affective ToM, there is very limited literature attempting to single out effects associated specifically with body sensations from a more general affective processing. Some studies employed modified ToM tasks focused specifically on pain (Bruneau *et al.*, 2012, 2015; Corradi-Dell'Acqua *et al.*, 2014, 2020; Jacoby *et al.*, 2016), however it is unclear whether the effects observed were indeed specifically due to pain or they rather reflected a broader effect of 'somatic sensations'. Saxe and Powell (2006) compared somatic sensations with cognitive ToM but failed to control for affective ToM.

The cognitive and emotional components of ToM are captured, respectively by the first and second factors of the quadrifactorial model of social cognition proposed by Blair and Cipolotti (2000): the cognitive component is assessed by requiring a person to understand the mental states of others (Baron-Cohen *et al.*, 1985; Happé, 1994), while the emotional component is assessed by asking her to attribute specific emotional states to the protagonists of scenes with an emotional content, respectively. The third factor in Blair and Cipolotti's model concerns a person's ability to judge, based on semantics, particular behaviors either as appropriate or violations, while the fourth factor has to do with the adherence to social rules, distinguished into moral and conventional rules.

It remains to be understood whether the second factor of Blair and Cipolotti's model could extend the general affective processing to body sensations. Observing an actor experience in the first-person perspective or simulating the actor's bodily sensation in attributing specific states activate body sensation (BS) in participants. Indeed, perceptions of others figure as contents of mental simulation (Gallese and Goldman, 1998; Gallese, 2009). For instance, the authors report an activation of the insula—a visceral/sensory cortex—when participants observe actors' disgusted facial expressions (Gallese et al., 2004).

In the present study we set out to investigate the neural correlates of the participants' ability to attribute specific states to others by relying on either emotion or sensation. As ToM is by hypothesis involved in both BS task and emotion task (E), we predicted that TPJ would be activated when participants performed either task.

To test this hypothesis, participants were asked to pay attention in the sentence to either the sensation expressed by the actor's body, or to the emotion supposedly in the actor's mind, using an Italian version of a task (Prior et al., 2003). In the emotion task (E), they were required to decide on the extent to which the actor is feeling a given emotion (e.g. 'How much <u>terrified</u> does she feel?'). In the BS task, instead, participants estimated how much the actor is feeling the sensation in a given body part (e.g. 'How much does she feel the sensation <u>in her face</u>?'). We hypothesized that a participant can solve this task by imagining in first person the bodily sensations of the actor. Our hypothesis is based on the evidence that different emotions are associated with culturally universal bodily sensations (Nummenmaa et al., 2014) They asked 701 participants to color on a silhouette the bodily parts where they felt a sensation while reading emotional words, stories, or watching movies, or facial expressions (Nummenmaa et al., 2013). The authors showed that the different emotions were consistently associated with statistically separable bodily sensation maps. Accordingly, in the BS task we administered, the participant had to pay attention to an actor's body part and decide the extent of actor's bodily sensation through perspective taking which, in turn, is expected to selectively activate areas involved in processing egocentric representations.

A recent meta-analysis from Schurtz et al. (2021), which applied the representation similarity analysis to meta-analytic maps on a wide range of paradigms testing ToM and empathy, showed that the neural response in this task can be modeled on three partially-segregated networks, involved in predominantly cognitive processes, affective processes and combined processes.

Methods and materials
Participants
Twenty-one healthy, right-handed (mean handedness $72.31 \pm 24.55\%$) subjects (9 M, 12 F, aged 22–48 years, mean age 30 ± 6.63 years) (Oldfield, 1971) participated in the study. They were all monolingual native speakers of Italian and had comparable levels of education (mean education 16.09 ± 2.71 years, range 8–18 years). The study was approved by the Ethics Committee of the IRCCS 'Eugenio Medea' Scientific Institute and written informed consent was obtained from each adult participant.

Experimental design
Stimuli
We used the same stimuli as in the subtest Test 'Emotion Attribution Test' devised by Prior et al. (2003). In particular, participants were presented with 30 randomly selected short stories of the original 58 describing emotional scenes happening to an actor (see Appendix). The sentences are univocally designed to trigger sadness, fear, embarrassment, disgust, happiness, anger or envy. An example on the scenario is 'Melania si trova in un vicolo. Un uomo sta andando verso di lei con un coltello', i.e. 'Melanie is in an alley. A man is walking towards her with a knife'.

Task and experimental paradigm
The functional magnetic resonance imaging (fMRI) protocol consisted of an event-related experimental design with two tasks. Participants were asked to pay attention to the 'BS' and to the emotion 'E' described by the stimuli.

Participants were instructed to silently read the series of sentences describing a scene as in the subtest Test 'Emotion Attribution Test' devised by Prior et al. (2003) and make an estimation on a 4-level scale (0–1; 2–4; 5–7; 8–10) by pressing the corresponding button. They were explicitly asked to pay attention to either the sensation on the actor's body or to the emotion in the actor's mind. We did not modify the items' presentation. We only added a brief question below each item. When they paid attention to the sensation on the actor's body (BS task) the estimation had to be made on how much the actor is feeling the sensation in a given body part. There was a fixed part of the phrase (e.g. 'How much does she feel the sensation in <u>her face</u>?') and a changing body part (the highlighted part of the sentence above). When they paid attention to the emotion in the actor's mind (E task) the estimation had to be made on how much the actor is feeling a given emotion. There was a fixed part of the phrase (e.g. 'How much terrified does she feel?') and a changing emotion (the highlighted part of the sentence above). The body part labels (i.e. hands, belly, rob, face and legs) were selected according to the stronger body part—-emotion associations as reported by the data from the Bodily maps of emotions' study (Nummenmaa et al., 2014) in which participants colored the body part associated with a given emotion. The emotion labels (i.e. happiness, embarrassment, fear, anger, sadness) were selected according to the correct emotion response in the 'Emotion Attribution Test' norming study (Prior et al., 2003). The BS questions (126.83 ± 34.28 characters) were significantly longer than the E questions (114.63 ± 35.3 characters, $t(29) = 22.81$, $P < 0.001$).

Instruction lasted 5 s. All experimental trials ($n = 60$, 30 BS, 30 E) had a duration of 9 s and were followed by a variable inter-trial interval, with a duration that was jittered between 3000 and 4000 ms, with incremental steps of 250 ms. In addition, a fixation cross (250 ms) was presented between trials, and 36 null events (i.e. blank screens) perceived as a prolongation of their inter-trial period were randomly interspersed among the event trials to increase the power of estimating the BOLD response (Dale and Buckner, 1997).

Visual stimulation was generated by using Presentation (Neurobehavioral Systems Inc., Albany, CA, USA) and presented by using the VisuaStimDigital (Resonance Technology Inc., Los Angeles, CA, USA) Goggle system. Responses were given by pressing four keys of an MRI Compatible Keypad (Resonance Technology Inc., Los Angeles, CA, USA) with the fingers of the right hand. Subjects practiced the task outside the scanner, prior to the magnetic resonance experiment, and utilized the dominant hand to respond.

MRI Acquisition
Images were acquired using a 3 T Achieva MR whole-body scanner (Philips, The Netherlands) with a standard 8-channel

head coil. High-resolution anatomical images were acquired using a 3D T1-weighted Turbo-Gradient Echo sequence (TR: 8.388 ms, TE: 3.85 ms, voxel size: 1 × 1 mm, thickness: 1 mm, number of slices: 190, field of view: 240 × 190 × 240 mm, acquisition matrix: 240 × 240, flip angle: 8°). Functional images were obtained using a T2*-weighted Gradient-Echo Echo-Planar Imaging EPI sequence (TR: 2500 ms, TE: 35 ms, voxel size: 1.797 mm × 1.797 mm, thickness: 3 mm, number of slices: 29, field of view: 230 × 88.33 × 230 mm, acquisition matrix: 128 × 128, flip angle: 90°, number of volumes: 308). Slices were acquired in the axial plane, parallel to the anterior commissure/posterior commissure (ACPC) line. The total scanning time was 20 min (12 min and 83 s the fMRI task plus the anatomical T1 acquisition).

Data analysis
Behavioral data
Behavioral performance was analyzed using SPSS 21.0 (SPSS, Inc., Chicago, IL) on subjects' reaction times and responses by performing an ANOVA with, as a factor, the task (attention to the body part 'BP' or to the emotion 'E').

fMRI data processing
fMRI preprocessing and statistical analysis were performed using MATLAB18r (The Mathworks, Inc., Natick, MA, USA) and SPM12 (Statistical Parametric Mapping software, SPM; Wellcome Department of Imaging Neuroscience, London, U.K. www.fil.ion.ucl.ac.uk/spm). The first four volumes of each functional dataset were discarded from analysis in order to allow for T1 equilibration effects.

We spatially realigned the images to the reference volume (i.e. the now first/previously seventh acquired volume) and then co-registered to the mean EPI image. The mean EPI image was normalized to the standard single subject template in Montreal Neurologic Institute (MNI) space. A Gaussian kernel of 6 mm full-width half-maximum was used for smoothing to meet the statistical requirements of the theory of Gaussian fields according to the General Linear Model (GLM) employed in SPM and to compensate for interindividual variability in macro- and microanatomical structures across subjects (Friston *et al.*, 1995a, 1995b).

For this experiment, three event-types were defined and then used as conditions for the model specification: (i) attention to body part, 'BP', and (ii) attention to emotion, 'E'. A GLM was thus applied to each voxel of the functional dataset. We used an event-related analysis and the BOLD response for each event type was modeled with the canonical Hemodynamic Response Function (HRF) and its temporal derivative. For this purpose, we convolved the HRF with an event train of delta functions at each stimulus onset of 0 s of duration. A temporal high-pass filter of 1/128 Hz and linear trend removal were employed. The three translation and the three rotation movement parameters obtained from the initial spatially realignment were included as further regressors.

Specific effects were assessed by applying appropriate linear contrasts of the parameter estimates of the four experimental conditions and the baselines resulting in *t*-statistics for each voxel. The set statistics were then Z-transformed to statistical parametric maps [SPM(Z)] of differences between the experimental conditions and between the experimental conditions and the baseline. [SPM(Z)] statistics were interpreted in light of the probabilistic behavior theory of Gaussian random fields (Friston *et al.*, 1995a, 1995b). For each subject we calculated the following
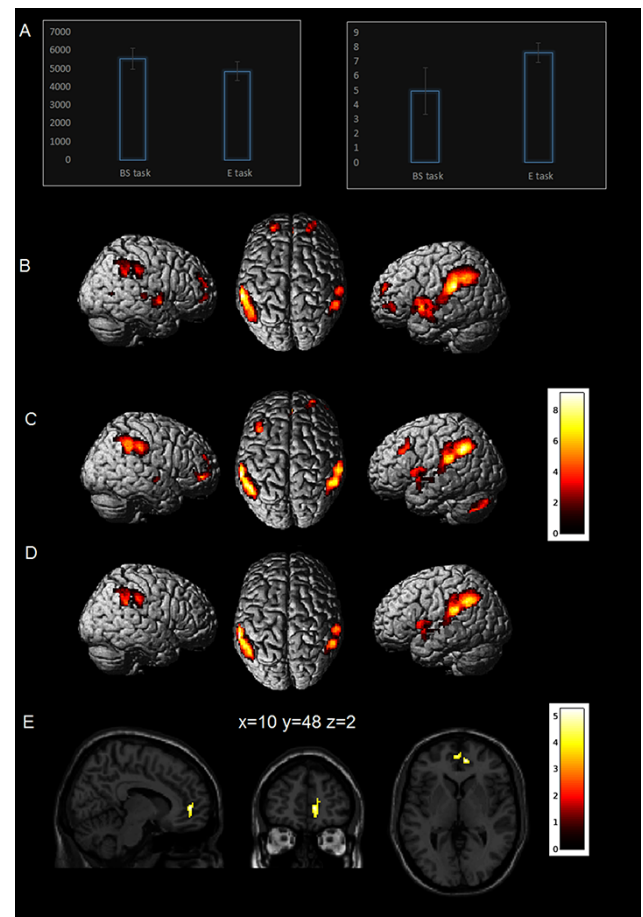

Fig. 1. (A) Behavioral results: Participants' mean reaction times (ms) on task performance (left panel) and their ratings (right panel). Subjects were significantly slower on the BP task than on the E task. Error bars indicate standard deviations (s.d.). (B) and (C) Relative increases in neural activity associated with the BP task (B) and the E task (C) ($P < 0.05$, corrected at the cluster level; see Table 1) are displayed on a rendered template brain provided by SPM12. (D) Common network activated by the BP and E tasks as revealed by the whole brain analysis. (E) The activation cluster in the left superior medial (and orbital) gyrus at the maximally activated voxel ($x = 10, y = 48, z = 2$) differentially recruited by the BP (relative to F) contrast.

contrast images: the simple contrasts tasks (BP and E), and the main effect of the task [BP–E] and [E-BP].

Second-level Random Effects Analyses were performed by using a *t*-test to create an SPM(T) on contrast images obtained from individual participants, in order to obtain significant activations specific for each contrast on a group level. We used a threshold of $P < 0.05$, corrected for multiple comparisons at the cluster level [using family-wise error (FWE)], with a height threshold at the voxel level of $P < 0.001$, uncorrected (see Woo *et al.*, 2014). Anatomical localization of the activations was done by using the SPM Anatomy Toolbox 3.0 (Eickhoff *et al.*, 2005).

Results
Behavioral data
Accuracy
The rating significantly differs between tasks [$F_{(1,20)} = 74.16$, $P < 0.001$, 6.82 BS task ± 1.62 *vs* 8.1 ± 7.6 E] (Figure 1E). Participants rated stronger the intensity of emotions (8.1 ± 7.6 E task)

Table 1. Brain regions showing significant relative increases of BOLD response associated with each comparison of interest

Side	Region	MNI coordinates			T	Size (k_E)
		x	y	Z		
Attention-to-BS Task-related network						
LH	Supramarginal gyrus	−58	−36	26	8.48	2436
RH	Supramarginal gyrus	60	−30	38	5.42	633
RH	Middle temporal gyrus	22	−26	16	6.47	364
LH	Anterior Insula	−38	6	8	6.50	1775
RH	Posterior Insula	42	−12	−4	5.16	777
RH	Superior frontal gyrus (medial segment)	4	48	6	7.26	1201
LH	Superior frontal gyrus	−24	54	22	6.43	273
LH	Inferior frontal gyrus (pars triangularis)	−46	44	0	4.80	207
Attention-to-Emotion (E) Task-related network						
LH	Angular gyrus	−48	−56	40	7.43	1759
RH	Supramarginal gyrus	66	−32	36	6.63	950
RH	Inferior temporal gyrus	40	−46	−2	6.64	248
RH	Superior temporal gyrus	50	−10	−6	5.54	180
LH	Cerebellum	−38	−80	−32	7.00	315
LH	Anterior insula	−38	6	10	6.46	902
LH	Middle frontal gyrus	−42	26	34	5.98	250
RH	Middle frontal gyrus	28	52	−2	5.24	366
RH	Superior frontal gyrus (medial segment)	6	46	20	4.76	171
Conjunction Analysis BS Task ∩ E Task						
LH	Supramarginal gyrus	−64	−38	30	6.46	1689
LH	Angular gyrus	−48	−54	38	6.44	
LH	Anterior insula	−40	4	−2	4.83	709
RH	Supramarginal gyrus	60	−30	38	5.42	616
RH	Angular gyrus	62	−48	32	4.84	
Main effect TASK [BS > E]						
M	Ventromedial prefrontal cortex	10	48	2	5.26	190

For each region of activation, the coordinates in MNI space are given referring to the maximally activated focus within an area of activation as indicated by the highest T-value.
LH/RH = left/right hemisphere, M= medial; Size = number of voxels in a cluster.
All the activations are significant at $P < 0.05$ (corrected for multiple comparisons at the cluster level, height threshold $P < 0.001$, uncorrected).

as compared to the intensity level of sensation in the body part (6.82 ± 1.62, BS task).

Reaction times

Reaction times were significantly longer [$\underline{F}(1,20) = 61.192$, $P < 0.001$] in the BS task (5554.49 ± 586.81) than in the E task (4867.52 ± 526.31). This result could be related also to the different lengths of the BS and E questions. We evaluated this hypothesis by performing an analysis of covariance with the length of sentences as a covariate. Results showed that there is a statistically significant difference between adjusted means for the BS task *vs* the E task ($P < 0.0001$) once their means had been adjusted for different length of the stimuli.

fMRI data

The attention-to-BS task-related network

Figure 1B shows that the task-related network of areas ($P < 0.05$, cFWE corrected) involved clusters of activity localized in the right middle temporal gyrus, left supramarginal gyrus, right supramarginal gyrus, left anterior insula, right posterior insula, left superior frontal gyrus, right superior frontal gyrus (medial segment) and left inferior frontal gyrus (pars triangularis).

The attention-to-emotion (E) task-related network

Figure 1C shows that the task-related network of areas ($P < 0.05$, cFWE corrected) involved clusters of activity were localized in (i) the right middle temporal gyrus, (ii) right superior temporal gyrus, (iii) the left angular gyrus, (iii) the right supramaginal gyrus, (iv)

the left cerebellum, (v) the left anterior insula, (vi) the middle frontal gyrus bilaterally and (vii) the right superior frontal gyrus (medial segment).

Conjunction analysis: BS task ∩ E task

Commonly activated areas ($P < 0.05$, cFWE corrected) by both tasks were localized in the supramarginal gyrus bilaterally (extending to the angular gyrus), and left anterior insula (see Figure 1D).

Main effect of task: BS task—E task (and vice versa)

The BS task (*vs* E task) differentially activated ($P < 0.05$, cFWE corrected) the ventromedial prefrontal cortex (VMPFC) (see Figure 1E). The reverse contrast (E task *vs* BS task) did not reveal any suprathreshold activation. The analysis comprising character lengths of the BS and E questions as a covariate revealed the same results.

Discussion

Using fMRI with healthy participants we investigated the relative neuronal contribution of bodily sensation or emotion. First, we observed the BS *vs* E main effect that led to a significant increase in activation in the VMPFC when participants performed the 'attention to the BS task' (*vs* 'attention to the E'). Extant neuroimaging literature indicates that VMPC is part of the network underlying ToM processes (e.g. Gallagher and Frith, 2003; Amodio and Frith, 2006; Stone *et al.*, 1998; for meta-analyses

see Molenberghs *et al.*, 2016; Schurz *et al.*, 2014; Hiser and Koenigs, 2018). Likewise, neuropsychological studies showing that ToM deficits may occur following damage to the VMPFC (e.g. Shamay-Tsoory *et al.*, 2003, 2005, 2007a; Shamay-Tsoory and Aharon-Peretz, 2007b). However, the conjunction analysis performed on both the BS and E tasks failed to return significant results in the VMPFC, suggesting that the differential activation in this area does not reflect a general effect of ToM task. There is indeed agreement that the ToM includes two components: a cognitive component, corresponding to the processing of others' beliefs, and an affective component, relying on emotional knowledge, through empathic appreciation of emotional states of others (e.g. Shamay-Tsoory and Aharon-Peretz, 2007b).

Our result complements previous studies which focused on the Cognitive *vs* Affective ToM distinction (Saxe and Powell, 2006; Bruneau *et al.*, 2012, 2015; Corradi-Dell'Acqua *et al.*, 2014, 2020; Jacoby *et al.*, 2016), as it adds data singling out effects associated specifically with body sensations from a more general affective perspective. Likewise, we found that the VMPFC was differentially activated during the ToM task when participants estimated the actor's bodily sensations. Estimating the extent to which the actor is feeling a sensation in a given body part, e.g. 'how much the actor is feeling the sensation in the chest?', likely requires processing egocentric representations. According to some patient studies, lesions to the VMPFC reduce the ability to process affective stimuli leaving the processing of cognitive stimuli intact (Shamay-Tsoory *et al.*, 2006), see also (Leopold *et al.*, 2012). In fact, damage to VMPFC may produce deficits in empathy (Barrash *et al.*, 2000; Shamay-Tsoory *et al.*, 2009), facial emotion recognition (Heberlein *et al.*, 2008; Tsuchida and Fellows, 2012) and moral judgments (Young and Koenigs, 2007; Fumagalli and Priori, 2012). Thus the activation of VMPFC we observed in our study may be related to the processing of bodily states in ToM tasks.

The activation of the VMPCF is in line with the view that we use the self as a reference for understanding others (Gordon, 1986) as in tasks eliciting self-related bodily information. There is also neuropsychological evidence showing that perspective-taking requires remapping of objects and locations coded with reference to the other person's body (e.g. Becchio *et al.*, 2013). Along the same line, we already reported that performing a mental rotation of body shapes (relative to letter shapes) engages egocentric representations that are modified by mental rotation (Tomasino *et al.*, 2016). Specifically, in a mental rotation task, participants imagine their own body into the position of the body stimulus and mentally rotate it until it matches the stimulus orientation. In that study, the contrast body shapes *vs* letter shapes lead to the activation of the VMPFC (Tomasino *et al.*, 2016). The VMPFC (and the insula) were found to be activated both by interoceptive information and subjective experience of emotion (Terasawa *et al.*, 2013).

Several studies identified the VMPFC as a neural correlate of self-related and perspective-taking processes (e.g. Northoff and Bermpohl, 2004). For instance, an activation of the VMPFC was observed when participants silently read sentences depicting their own ('self' task) or another person's ('other' task) personality traits or social issues ('society' task) (D'Argembeau *et al.*, 2005). An activation very close to the one we reported here was observed in self-referential processing ($x = -8$, $y = 50$ and $z = -2$, away from our coordinates only by 2 mm in x, 2 mm in y and 0 mm in z plane), and not in perspective taking itself ($x = -4$, $y = 52$ and $z = -1$), when participants judged the appropriateness of an adjective for the self *vs* the other person (D'Argembeau *et al.*, 2007). In other study, in which participants judged how different adjectives are relevant

for the self, an activation in the VMPFC was obtained in association with self-relevant adjectives (at $x = -6$, $y = 53$ and $z = 6$) relative to adjectives considered less self-relevant (Moran *et al.*, 2006). Similarly, an activation in the VMPFC (at $x = 0$, $y = 54$ and $z = -15$) was found while subjects viewed emotionally charged pictures and, post-fMRI measurements, judged the self-relatedness of the stimuli (Schneider *et al.*, 2008). Results showed that activation in the VMPFC was parametrically modulated by the subjects' self-relatedness judgments. Single-neuron recordings in the dorsomedial prefrontal cortex of interacting Rhesus macaques code for details of the interaction, such as identity, context, and interaction history (Báez-Mendoza *et al.*, 2021). The neurons from which the authors recorded were located in the more medial part of the Brodmann's area 24, just above the activation cluster we observed in our study.

Lastly, previous studies comparing affective ToM with pain inferences showed activation in the supramarginal gyrus, in the insula and also in one case also to VMPFC. For instance, Saxe and Powell (2006) found supramarginal activation for inferring somatic sensations *vs* Cognitive ToM. Other few studies (Bruneau *et al.*, 2012, 2015; Corradi-Dell'Acqua *et al.*, 2014, 2020; Jacoby *et al.*, 2016) compared affective ToM with pain inferences, associating the latter to the insular cortex (especially the posterior/opercular portion), and in one case also to VMPFC. In this perspective, we can speculate that these previous studies on pain inferences reflect, although at a more general level with respect to our BS task, inference of somatic sensations.

We acknowledge a limitation in our study consisting in the lack of a control condition testing Cognitive ToM. In fact, it is unclear whether the network triggered by E and BS tasks reflects purely affective/somatic inference or it also engaged by cognitive ToM processes. However, we are positive that this should not weaken our key result, that is the selective activation of the VMPFC during the BS task, obtained by contrasting different task demands on the same stories, which evoked similar idiosyncratic considerations about the protagonist's thoughts.

Conclusion

When participants performed a ToM task paying attention to the either bodily sensations or emotions activated a core region in the TPJ, parietal cortex, DLPFC, MPFC and insula. By contrast, only when participants paid attention to the bodily sensations, self-related bodily representations were selectively activated in the VMPFC.

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Conflict of interest

The authors declared that they had no conflict of interest with respect to their authorship or the publication of this article.

Author contributions

R.I.R. and B.T. designed the study, C.C. acquired the data; B.T. and C.B. analyzed the data; B.T. and R.I.R. wrote the paper; all authors edited the paper; all authors revised the final version of the manuscript.

Data availability

The datasets analyzed for this study will be made available from the authors upon request.

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Appendix

List of items (from the 'Emotion Attribution Test' by Prior *et al.* (2003), body part (BP) and emotion (ADJ) for the attention to the bodily sensation (BS) task and for the attention to the emotion (E) task.

Item *n.*	FBS How much does she/he feel the sensation in her/his [BP]	FE How much [ADJ] does she/he feel
1	Bell	Sad
6	Rob	Sad
8	Face	Sad
31	Bell	Disappointed
41	Rob	Disappointed
57	Face	Disappointed
7	Face	Scared
11	Rob	Scared
21	Bell	Scared
26	Hands	Frightened
43	Bell	Frightened
46	Rob	Frightened
3	Rob	Embarrassed
14	Bell	Embarrassed
17	Face	Embarrassed
44	Face	Ridiculous
47	Bell	Ridiculous
52	Rob	Ridiculous
5	Face	Happy
16	Rob	Happy
20	Bell	Happy
22	Hands	Enraptured
32	Leg	Enraptured
42	Face	Enraptured
12	Hands	Angry
13	Rob	Angry
33	Face	Angry
45	Rob	Bothered
49	Hands	Bothered
53	Face	Bothered