

system involves the dorsal prefrontal cortex that allows for explicit reasoning about stimuli–emotion associations.

Recent imaging studies show that the ventromedial prefrontal cortex (VMPFC), the perigenual anterior cingulate cortex (PACC), and the dorsomedial prefrontal cortex (DMPFC) are also involved in relating emotional stimuli to the self. Phan *et al.* [2] observed that the degree of emotional self-relatedness (as obtained in subjective ratings) was associated with signal changes in VMPFC, PACC and DMPFC: The more self-related the picture content was appraised by the subject, the more activation was observed in these regions. In another study [3], signal changes in DMPFC were related to positive and negative emotional personality trait adjectives. This is in line with an earlier study by Gusnard *et al.* [4] where self-related (i.e. internal) attention to emotional stimuli induced signal changes in PACC, VMPFC and DMPFC when compared with non-self-related (i.e. external) attention. Finally, Ochsner *et al.* [5] observed increased recruitment in PACC during self-referent emotional contents (self-focus) as compared with situational context meanings (situation-focus). Although this is shown in their review in Figure 3c it is not discussed.

This suggests an overlap between self-relatedness and emotion regulation in anterior cortical midline regions. Is self-referential processing one way to regulate emotion? One could, for example, imagine that the degree of self-relatedness controls the subjective experience of emotion, that is, feelings. The more activation in VMPFC, the more self-related an emotional stimulus will be evaluated, leading to increased personal involvement with stronger feelings. Conversely, the less the VMPFC is activated, the less self-related an emotional stimulus, resulting in less personal involvement with weaker feelings.

Future studies should focus on directly comparing self-referential processing and stimulus–reward reversal learning vs extinction; this could answer the question of whether self-referential processing is a separate process or not (see also [6,7]). Furthermore, one could investigate the interference between self-referential processing and other emotion regulation mechanisms (anticipation, attentional distraction, reappraisal). This could contribute to the issue of whether self-referential processing is a higher-order cognitive process by itself, or whether it is a more basal process underlying higher-order cognitive mechanisms of emotion regulation.

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Letters Response

Putting the ‘I’ and the ‘Me’ in emotion regulation: Reply to Northoff

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Northoff’s comment [1] raises important questions about the role of the self in emotion regulation. Space constraints precluded our addressing these questions in our original article [2]. We are therefore delighted to have the chance to consider them here.

More than a century ago, William James [3] distinguished between two aspects of the psychological self: the ‘I’ and the ‘Me’. James’s ‘I’ is the first-person agentic ‘doer’ that in the context of emotion regulation inhibits prepotent responses, generates reappraisals, and so on. Because the ‘I’

aspect of self accompanies all goal-directed activities, it is involved in all forms of self-regulation, not just those involving the cognitive control of emotion. Research has just begun to examine the neural bases of this aspect of self, but we believe that, depending upon the task and context, different combinations of neural systems (including, for example, dorsolateral prefrontal cortex and anterior cingulate cortex) may be involved in the agentic, ‘I’ mode of regulatory control over emotion and other processes.

By contrast, James’s ‘Me’ is the third-person object of self-reflection about one’s traits (*‘am I friendly?’*), beliefs (*‘do I like chocolate?’*), states (*‘am I angry?’*) and so on. The

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'Me' can participate in emotion regulation in numerous ways, including self-monitoring of one's changing emotional states and the personal relevance of events. We believe that medial prefrontal cortex (MPFC) plays a special role in the 'Me' mode of self reflection [4–6]. For example, as Northoff notes (and as was noted in the legend to Figure 3c of our original article, but not elaborated upon because of space limitations), we have found MPFC activity to be associated with attempts to decrease the personal relevance of emotional stimuli by becoming a detached observer [6]. Elsewhere [4,6] we have argued that dorsal MPFC may be important for tracking changes in emotional state and perceived self relevance of stimuli during reappraisal and other forms of emotion regulation. It is also possible that dorsal and ventral MPFC perform distinct but related functions during self-reflective, self-regulatory, social-cognitive and affective processing, as suggested by our work on the appraisal of emotions and traits in self and others [5,7] and similar work by several other groups [8–10].

In summary, we agree with Northoff that MPFC probably plays a role in both self reflection and emotion regulation. The challenge for future research is to characterize more fully the rich interplay between James's 'I'- and 'Me'-related psychological processes and underlying neural systems in the context of self-regulation.

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Letters

Thinking harder about false belief

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Russell is right to claim that researchers should think harder about false belief [1]. Commenting on Riggs and Simpson's recent findings that young children have difficulty ascribing past true beliefs [2], he urges researchers to resist the conclusion that children have a problem with beliefs in general. Instead, he argues that children's difficulty is with 'currently false' beliefs. He also reports on two alternative explanations for why children fail false-belief tasks:

- (1) Children fail to inhibit their own current knowledge of reality [3]
- (2) Children have an immature conception of belief [4]

I would like to ask two questions. First, why do children have a problem with currently false beliefs when asked questions about belief, but little or no difficulty when asked questions about past reality? Children can easily report that the book was in location A at the start of the story, even though they have difficulty ascribing to a

protagonist the belief that the book was in location A. In both cases, the answer is, in Russell's terminology, a 'currently false' belief.

Second, why should we view an inhibitory account and an immature-conception-of-belief account as alternative explanations for children's poor performance on false belief tasks?

This difference in performance between 'reality' and 'belief' questions brings into focus an important question: why do children have a problem ignoring their own current knowledge of reality when answering questions about belief, but not when answering questions about past reality? One possibility relates to how we might answer these questions in different ways. Perhaps answers to belief questions are *inferred*, but answers to questions about reality are *recalled* from memory [5].

Another possibility – and this relates to my second question – is that children have difficulty ignoring their own current knowledge of reality when asked belief questions *because* they have an immature conception of belief [6]. If children assume that beliefs are true, then

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