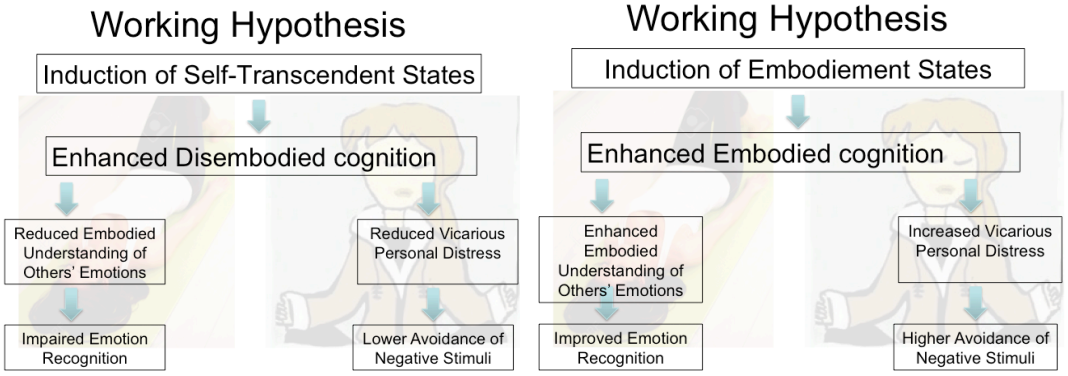
PUBLISHABLE SUMMARY

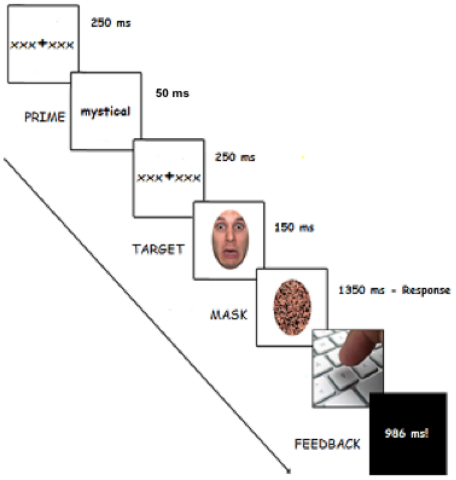
Grant Agreement: **625488** Project acronym: **SPIRIT** Funding Scheme: **FP7-MC-IEF**
Title: **Spiritual Brains and Embodied Minds: Neural Bases of Self-Transcendence and Empathy**
Beneficiary: **Bangor University, Wales, UK**
Scientist in charge: **Prof. Paul E. Downing** (p.downing@bangor.ac.uk)
Fellow: **Dr. Cosimo Urgesi** (c.urgesi@bangor.ac.uk)

Objectives. The representation of our own and others' mental events is strongly linked to mapping internal bodily states (embodiment). At the same time, the ability to transcend actual body perceptions and actions (self-transcendence) and to project self-images into scenarios that are not entirely transparent to sense modalities (spirituality) is inherently linked to human beings. SPIRIT aims to study the cognitive processes and neural mechanisms underpinning the influence of self-transcendence and spirituality on the embodied instantiations of social perception and empathy.

Work performed and main results. Starting from an operational definition of spirituality, which tells it apart from more institutional constructs, such as religiosity, and general positive self representations, such as self esteem, SPIRIT has collected a series of explicit measures of spirituality and empathy and has developed new implicit measures for the same constructs. In addition to using implicit measures of spirituality and religiosity, we also used mindfulness and Yoga practices as proxy to self-transcendent. In particular, we compared the effects of Yoga and Mindfulness practices on the ability to recognize emotions in others' faces and bodies. Results showed that the Yoga practice, which is supposed to enhance embodiment, heightened recognition of face but not body emotional expressions as compared to both baseline and Mindfulness practices. No effects were obtained for a gender recognition task, thus suggesting that spiritual practice specifically affects emotion processing rather than person perception. In a follow up study, we compared with Yoga the effects of a different mindfulness practice, which is related to decentering from thoughts, in individuals with or without previous experience with mindfulness. Results showed that decentering vs. embodied practice may induce different effects on the emotion recognition abilities of experts and non experts. All together, these findings show that even short embodiment or decentering inductions may boost emotion recognition abilities, providing experimental support to the view that social perception relies, at least partially, on embodied representations.



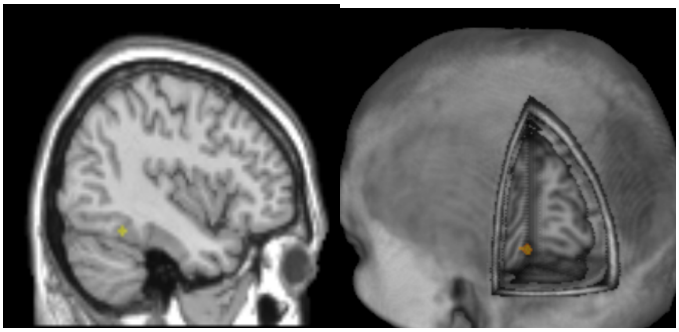
The link between self-transcendent representations and emotion recognition was further investigated using the spiritual words identified for the Implicit Association test to activate self-transcendent representation of the self before an emotion recognition task. Results confirmed the original hypothesis that activating spiritual self-representation reduces the embodiment of others' emotions and, hence, the ability to recognize them.

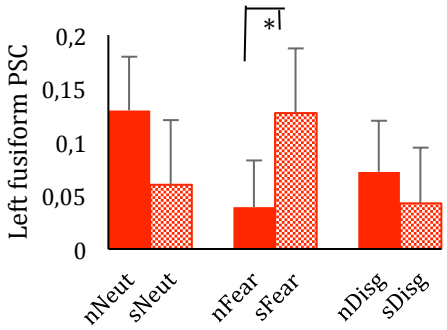


Furthermore, in a single-pulse transcranial magnetic stimulation (TMS) experiment we recorded motor evoked potentials from arms and forearm muscles to study how the observer's motor system was affected by presentation of spiritual primes. Results showed that presentation of spiritual words reduced motor facilitation during emotion perception, suggesting that priming spiritual representations alters the mapping of others' emotions onto the observer's motor system.

In another experiment, we delivered a single TMS over the inferior parietal cortex, which has been involved in processing self-body representation. Results showed that TMS interference with the inferior parietal cortex disrupted the spiritual priming effect, thus suggesting that priming effects relied on the activation of self-transcendental representations in the parietal cortex.

Finally, we used fMRI to record neural responses to different facial emotions (neutral, fear, disgust) while performing a forced-choice lexical priming task (spiritual or non-spiritual). Results showed that activation of spiritual representations increased the response to emotions in perception areas in the fusiform gyrus, but it did not affect areas involved in emotional processing.





Final results. Overall, these results suggest that changing the way people represent their transcendental nature affects how they perceive and embody others' emotions.

Impact. Integrating brain stimulation with learning state-of-the-art brain activation methods, SPIRIT fosters a multimodal approach to explore how the complex neurofunctional organization of the human brain allows the development of spiritual self-representations and the reaching of more abstract (dis-embodied) forms of social perception. Merging together the investigations of spirituality, self-transcendence and embodied social cognition will ultimately allow for a better understanding of how the brain represents the social self.