Unimodal and multimodal plasticity reflects multisensory driven changes in self-recognition

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Introduction:

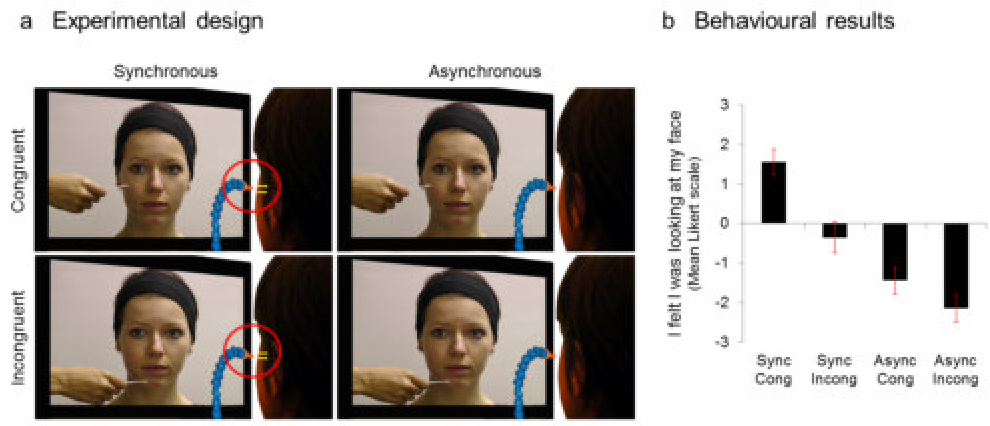
Nothing provides as strong a sense of self as seeing one's face. Nevertheless, it remains unknown how the brain processes the sense of self during the multisensory experience of looking at one's face in a mirror. It has been shown that synchronised visuo-tactile stimulation on one's own and another's face, an experience that is akin to looking in the mirror but seeing another's face, causes the illusory experience of ownership over the other person's face and changes in self-recognition, akin to other bodily illusions (Sforza et al., 2010; Tajadura-Jimenez et al., 2012a; Tajadura-Jiménez,et al., 2012b; Tsakiris, 2008)

Previous studies have identified a network of areas that is engaged during self-recognition when viewing static images, including unimodal face selective areas, such as the Inferior Occipital gyrus (IOG), and multimodal areas, such as the Intraparietal Sulcus (IPS) and the Temporo-Parietal Junction (TPJ) (Apps et al., 2012; Uddin et al., 2005). However, static stimuli violate the dynamic, multisensory conditions that are present when looking at one's self in a mirror. Here we used a block design fMRI to examine the activity in the brain during the enfacement illusion as a corollary of the neural processes that underpin the dynamic, multisensory conditions of mirror self-recognition.

Methods:

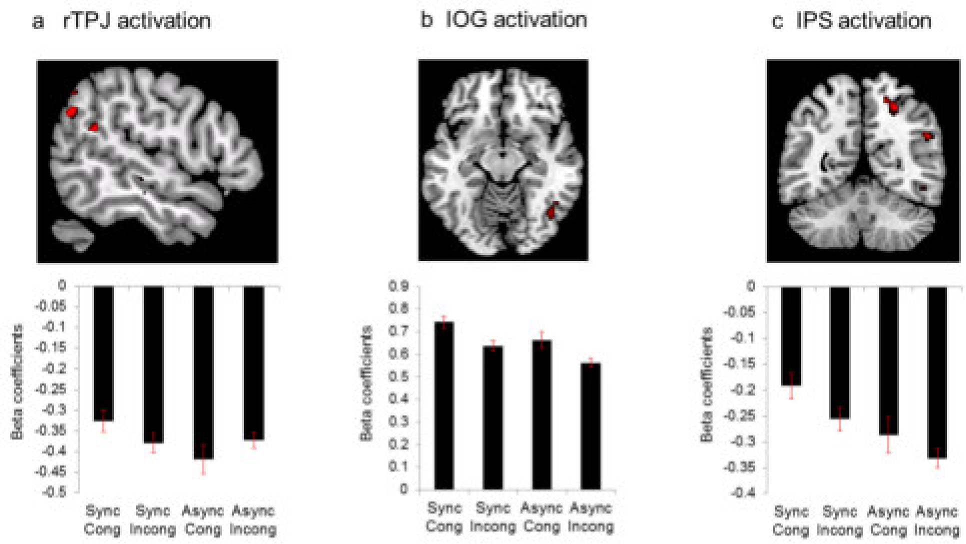
15 female participants, who were found to experience the enfacement illusion during a pilot study, underwent blocks of multisensory stimulation during scanning. Participants saw 40s videos in which a female model was touched with a tap of a cotton-bud on the right cheek or on the right hand side of the chin, at a random frequency ranging from 0.33 to 0.76 Hz. During these videos participants also received tactile stimulation to their face through an airpuff delivery system. We used a 2x2 design. The first factor was the temporal synchronicity of the stimulation, which could be either synchronous or asynchronous. The second factor was the specular congruency, which could be congruent (on the cheek of the participant and the model in the video) or incongruent (on the cheek of the participant, but on the chin of the model in the video). Based on previous studies we predicted that synchronous visuo-tactile stimulation on the congruent location should elicit the illusory experience. At the end of each block, participants were required to report their level of agreement with the statement "I felt I was looking at my face", using a 7-item Likert scale displayed on the screen.

We analysed the fMRI data using two approaches. First, we analysed the data using the factorial design, to look for areas which showed an interaction between synchronicity and congruency. Second, we performed a parametric analysis, which looked for activity that was scaled with the subjective experience of the illusion, regardless of the condition in the factorial design. We report activity only in areas that showed an interaction in the factorial analysis and a parametric effect.



Results:

Activity in a network of areas including the IOG (50, -68, -4; Z = 5.45, $p < 0.05$FWE), the TPJ (54, -48, 20; Z = 5.45, $p < 0.05$FWE) and the IPS (28, -58, 52; Z = 5.21, $p < 0.05$FWE) showed an interaction effect between the synchronicity and congruency of the visuo-tactile stimulation between one's own and another person's face. Activity in these areas was also scaled with the extent to which participants felt like they were looking at themselves ($p < 0.05$svc).



Conclusions:

Given the known role of the IOG in face recognition (Barraclough & Perrett, 2011), and of the TPJ and IPS in multisensory integration and bodily illusions (Blanke, 2012), these results highlight the important interplay between bottom-up unimodal and top-down multimodal information processing during the enfacement illusion. We suggest that such mechanisms also drive mirror self-recognition. Our results therefore provide an anatomical basis for the neural plasticity that drives the dynamic, multisensory processing of one's face in a mirror.

Social Neuroscience:

Self Processes

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