

Functional connectivity of Insula related to eye movements and genital response during visual erotic stimulation.

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Background: The insula is a bilateral deep brain structure involved in several cognitive and emotional processes. A number of studies have highlighted its role in sexual behavior.

Research question: The current study is the first to examine the relationships among genital responses, brain responses, and eye movements, in an attempt to disentangle the role played by different sub regions of the Insula during different stages of male sexual response.

Method: 19 healthy men participated in this study (age: 25-45). After urological and clinical assessment, fMRI data were collected using a 3T Siemens scanner during the presentation of sexual and neutral clips (VSS). The following T2* parameters were used: EPI, TR = 2500ms, TE = 30ms, voxel size 2.5x2.5x3mm, 360 volumes-max and 39 slices; and T1 parameters: matrix = 256x256, FOV 256mm, voxel size 1mm³, flip angle 12°. Penile tumescence (PT) and eye saccades and fixations were continuously measured. After pre-processing and Talairach normalization, single and multi-subject GLM, a one-way voxel-wise RFX-ANOVA was used to compare brain activity during the erotic and neutral movies. Given the results, involving the bilateral insulae ($p < 0.05$ FDR corr.) during the comparison, 3 bilateral seed regions (anterior, middle and posterior) of the insula were selected on the anatomical bases. We then calculated correlations between Seed time-courses (i.e.: the time-course in each of the insula sub-regions) and all the time-courses of the brain voxels and a between hemisphere comparison. To test the role of each subregion FC connectivity pattern related to in the eye-movements, single and multi-subject GLM were performed on the bases of the areas of interest (AOI) to which subjects directed their visual attention (fixations). The AOIs were “Faces”, “Genitalia,” and “Background”. A series of single-ROI GLM with the contrast “Genitalia” > “Faces” was applied. In the same way, a series of single-ROI GLM with baseline (Bpt) onset (Opt) and sustained (Spt) PT response during the sexual clip was applied (Opt > Bpt and Spt > Opt).

Results: The comparison between the left and right portion of each subregion was carried out to study specific lateralization effects. The comparison between Left Anterior > Right Anterior showed a positive correlation with BA46 (ventrolateral PFC); whereas a positive correlation was observed for the Right Anterior Insula and the right Orbitofrontal cortex, Subgenual ACC and Nucleus Accumbens. The right Middle Insula in the established FC with the bilateral frontopolar areas (BA10). The last comparison, between Left > Right Posterior Insulae, showed a positive FC between Left Posterior Insula and Left BA7, Left BA40, Left TPJ and PCC (BA31) bilaterally ($p < 0.05$ Bonf.corr). For eye fixations, the left > right Posterior Insula comparison showed a significant contrast (Genital > Face) for the BA31 ($p < 0.001$). For the Genital Response phases, in particular Opt > Bpt for the left > right Posterior Insula in the right BA31 ($p < 0.0001$) and in the left BA31 ($p < 0.0001$). For the contrast Spt > Bpt the left > right posterior insula showed significant contrasts in right BA31 ($p < 0.0005$). All the results are Bonferroni’s corrected.

Conclusions: According to Stoleru (2012), Posterior Insula is part of the “emotional component” of sexual arousal related to the cognition. According to our findings, it is conceivable to hypothesize a more complex role for this specific region: 1) we found a hemispheric specialization for the posterior insula in a context of VSS. 2) Post-Insula is responsible for the monitoring interoception and bodily changes due to VSS and this peculiar and important activity has a predominant control on other cognitive and emotional functions like focused attention, integration with emotional arousal, cognitive empathy and context integration

Key Words: fMRI, Visual Sexual Stimulation (VSS), Male sexual arousal, Posterior Insula, Visual Attention.

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