

Volumetric effects of hormonal contraceptives and menstrual cycle phase in the fusiform gyrus: a VBM study

Timo De Bondt^{1,2}, Wim Van Hecke³, Jan Sijbers⁴, Yves Jacquemyn⁵, Stefan Sunaert⁶, and Paul M Parizel^{1,2}

¹Radiology, Antwerp University Hospital, Antwerp, Antwerp, Belgium, ²Radiology, University of Antwerp, Antwerp, Antwerp, Belgium, ³icoMetrix, Leuven, Belgium, ⁴Physics, University of Antwerp, Antwerp, Antwerp, Belgium, ⁵Gynaecology and Obstetrics, Antwerp University Hospital, Antwerp, Antwerp, Belgium, ⁶Radiology, University Hospitals of the Catholic University Leuven, Leuven, Belgium

Target audience: Neuroscientists and behavioral scientists

Purpose: Because of its link to pathologies, aging, brain plasticity, etc. voxel based morphometry has been widely used to detect local differences in brain anatomy. Studies have shown a functional and morphological dependency of menstrual cycle phase on the brain, which are associated with changing hormone levels of estradiol and progesterone. However, the factor using the combined oral contraceptive pill (COCP) has, to the best of our knowledge, never been considered. It is known that hormonal concentrations of estradiol and progesterone are dramatically lowered when using COCP. In this study we compare 2 different low hormone situations, one with COCP and one with a natural cycle to a high hormone situation, the luteal phase in the natural cycle. Our hypothesis is that both effects would be similar.

Methods: A healthy control population of 30 young women (age between 18 and 28 years) was enrolled in the study, from which 15 had a natural menstrual cycle and 15 were on hormonal contraceptives. High resolution anatomical T1 weighted images were acquired using a 3T scanner (Siemens Trio Tim, Erlangen, Germany) with an isotropic resolution of 1mm³. Data was analyzed using SPM8. Initial manual alignment was performed prior to segmentation and DARTEL¹ registration.

Results: Resulting maps were statistically analyzed using (paired) t-tests. Voxels were considered significant when p-value was lower than 0.005, uncorrected. We compared a low hormone phase to a high hormone phase, both intragroup and intergroup. More specifically, we compared follicular (low hormone) and luteal (high hormone) phase in the natural cycle group, and we compared women on COCP with luteal phase from the natural cycle group. We found a significant increase in fusiform volume in the high hormone phase, compared to both low hormone phases (Figure 1).

Discussion: An fMRI study of Guapo et al.² showed that the ability to identify angry and sad faces was proportional to concentrations of estrogen and progesterone. Although there is no clear consensus, the fusiform has been associated with facial recognition.³ Since differences in the size of brain structures are thought to reflect their relative importance, our data supports these findings on a morphological basis.

Conclusion: When designing a morphological or fMRI study, the factor of hormonal contraception and menstrual cycle phase should be taken into account. Moreover, further studies might shed light on possible behavioral alternations introduced by hormonal contraceptives use.

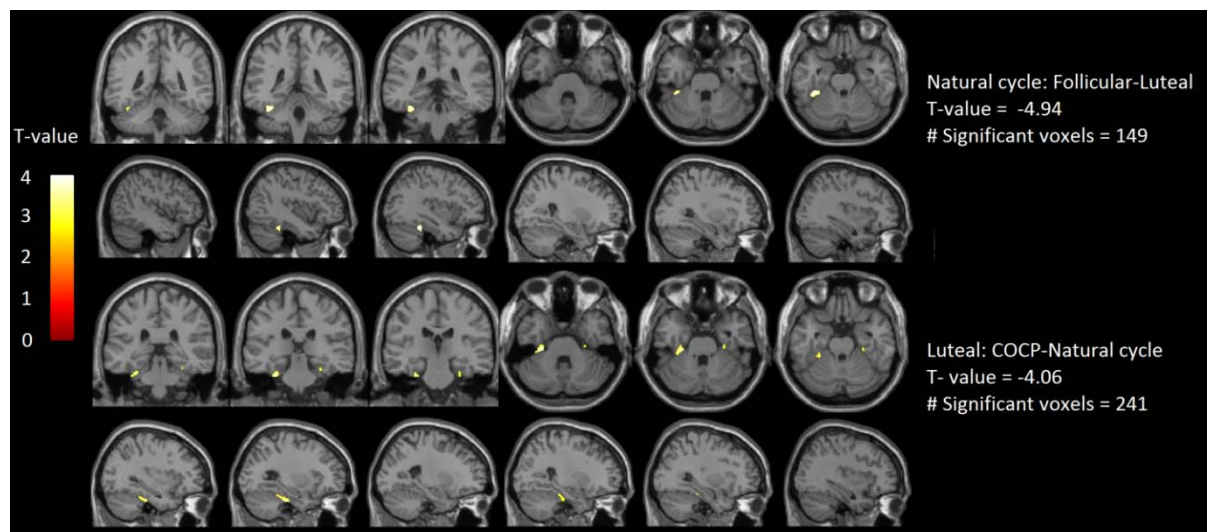


Figure 1: The fusiform significantly different voxels comparing follicular and luteal phase in the natural cycle group (upper 2 rows), and comparing COCP and natural cycle group in the luteal phase (lower 2 rows).

References: [1] Ashburner J. A fast diffeomorphic image registration algorithm. Neuroimage. 2007; 38(1):95-113. [2] Guapo VG, Graeff FG, Zani AC, et al. Effects of sex hormonal levels and phases of the menstrual cycle in the processing of emotional

faces. Psychoneuroendocrinology. 2009; 34:1087-94. [3] Hadjickani N, Kveraga K, Naik P, Ahlfors SP. Early activation of face-specific cortex by face-like objects. Neuroreport. 2009; 20:403-7.