

Purpose

Delineate the neural underpinnings of aesthetic judgments

Introduction

Previous research in neuro-aesthetics identifies certain emotional brain centres, amongst which is the amygdala, as responsive to the aesthetic status (beautiful, neutral, ugly) of the stimuli [1-7]. The amygdala is believed to be involved mainly in bottom-up processing [18], with top-down effects exerting at most a modulatory role. We sought to zoom in on the bottom-up role of valence by using a class of non-arousing stimuli, namely visual textures. The arousal factor has hitherto not been controlled for in neuro-aesthetics research.

Background

One study found differential activation between a task of judging for beauty and judging for symmetry [8]. Top-down effects on the amygdala have been reported in experiments employing e.g. facial expressions or IAPS pictures, although the direction and presence of effects are inconsistent (see [9-15]), and may depend on task difficulty [16].

Factors like arousal-potential of the stimuli may explain the bottom-up effects on the emotional nuclei [17], but controlling for arousal still yields effects of affective intensity [19], i.e. of valence.

Expectations

- Beautiful & ugly textures evoke more activity in amygdala
- This effect will be strengthened under direct beauty judgments, compared to indirect judgments

Method

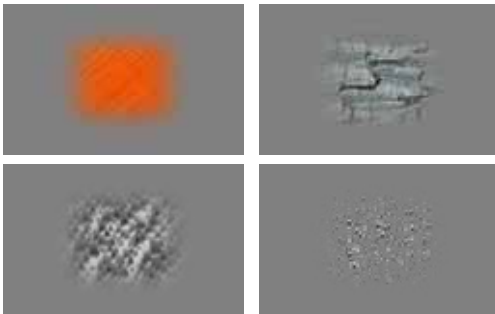
10 male and 8 female participants.

12 ugly, 12 neutral, and 12 beautiful textures selected based on individual preferences.

Separate blocks for judging beauty, roughness, naturalness.

fMRI: 8-channel SENSE coil, BOLD: TR = 2500 ms, 40 slices, 3.5x3.5x4 mm. 3 runs of 350 volumes each.

Analysis: BrainVoyager. Realignment, slice time correction, spatial smoothing (FWHM = 8 mm), coregistration, normalization. Full brain analysis, 3 (beauty status) x 3 (judgment) factorial design.



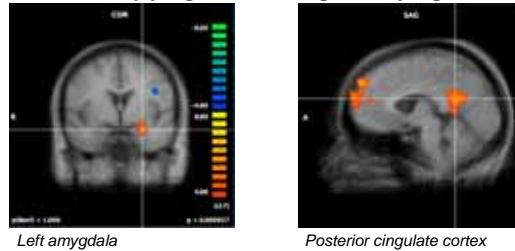
Example textures, as displayed in the fMRI-experiment

Results

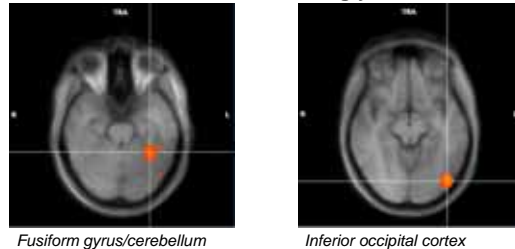
We found no effects on amygdala activation

- of beauty-status
- of an enhancement of amygdala activation during beauty-judgments, specific for beautiful and/or ugly textures

Beauty judgments > roughness judgments



Beautiful textures > ugly textures



Conclusion

Amygdala

Top-down effects in the (unexpected) absence of bottom-up effects, using textures. Inconsistent with:

- view of the amygdala as mainly involved in bottom-up processing, with top-down effects exerting at most a modulatory role [18]
- theories proposing mainly a social evaluative role for the amygdala [e.g., 20]
- stimulus-driven valence and arousal accounts [17]

With low-arousal stimuli, a general top-down boosting of amygdalar activation appears to be necessary for making aesthetic judgments

Other

- Posterior cingulate cortex activity during beauty judgments may reflect enhanced attention to internally generated signals [21] in beauty judgments
- Visual cortex activation may reflect enhanced attention to beautiful stimuli

Similar findings have been reported previously [8, 22]

[1] Cela-Conde, C., Marty, G., Maestú, F., Ortiz, T., Munar, E., Fernandez, A., Roca, M., Rosselló, J., & Quesney, F. (2004). Activation of the prefrontal cortex in the human visual aesthetic perception. *PNAS*, 101, 6321-6325.

[2] Kawabata, H. & Zeki, S. (2004). Neural correlates of beauty. *Journal of Neurophysiology*, 91, 1699-1705.

[3] Osaka, N., Ikeda, T., Rentscher, I., & Osaka, M. (2007). PPA and OFC correlates of beauty and ugliness: An event-related fMRI study [Meeting Abstract]. *Perception*, S36, 174-175.

[4] O'Doherty, J., Winston, J., Critchley, H., Perrett, D., Burt, D.M., & Dolan, R.J. (2003). "Beauty in a smile: the role of medial orbitofrontal cortex in facial attractiveness". *Neuropsychologia*, 41, 147-155.

[5] Aharon, I., Etcoff, N., Ariely, D., Chabris, C.F., O'Connor, E., & Breiter, H.C. (2001). Beautiful faces have variable reward value: fMRI and behavioural evidence. *Neuron*, 32, 537-551.

[6] Rolls, E.T., O'Doherty, J., Kringelbach, M.L., Francis, S., Bowtell, R., & McGlone, F. (2003). Representations of pleasant and painful touch in the human orbitofrontal and cingulate cortices. *Cerebral Cortex*, 13, 308-317.

[7] Calvo-Merino, B., Jola, C., Glaser, D.E., & Haggard, P. (in press). Towards a sensorimotor aesthetics of performing art. *Consciousness and Cognition*.

[8] Jacobsen, T., Schubotz, R.I., Höfel, L., & Yves v. Cramon, D. (2006). Brain correlates of aesthetic judgment of beauty. *NeuroImage*, 29, 276-285.

[9] Di Dio, C., Macaluso, E., & Rizzolatti, G. (2007). The golden beauty: brain response to classical and renaissance sculptures. *PLoS ONE*, 2, e1201.

[10] Pessoa, L., Kastner, S., & Ungerleider, L. G. (2002). Attentional control of the processing of neural and emotional stimuli. *Brain Res Cogn Brain Res*, 15, 31-45.

[11] Gorno-Tempini, M.L., Pradelli, S., Serafini, M., Pagnoni, G., Baraldi, P., Porro, C., Nicoletti, R., Umiltà, C., & Nichelli, P. (2001). Explicit and incidental facial expression processing: an fMRI study. *NeuroImage*, 14, 465-473.

[12] Critchley, H., Daly, E., Phillips, M., Brammer, M., Bullmore, E., Williams, S., Van Amelsvoort, T., Robertson, O., David, A., & Murphy, D. (2000). Explicit and implicit neural mechanisms for processing of social information from facial

[13] Winston, J.S., O'Doherty, J., & Dolan, R.J. (2003). Common and distinct neural responses during direct and incidental processing of multiple facial emotions. *NeuroImage*, 20, 84-97.

[14] Habel, U., Windschberger, C., Dermt, B., Robinson, S., Kryspin-Exner, I., Gur, R.C., & Moser, E. (2007). Amigdala activation and facial expressions: Explicit emotion discrimination versus implicit emotion processing. *Neuropsychologia*, 45, 2369-2377.

[15] Bleich-Cohen, M., Mintz, M., Planka, P., Anselman, F., Rothstein, P., Hendler, T. (2006). Differential stimuli and task effects in the amygdala and sensory areas. *NeuroReport*, 17, 1391-1395.

[16] Lange, K., Williams, L.M., Young, A.W., Bullmore, E.T., Brammer, M.J., Williams, S.C.R., Gray, J.A., & Phillips, M.L. (2003). Task instructions modulate neural responses to fearful facial expressions. *Biological Psychiatry*, 53, 226-232.

[17] Costafreda, S.G., Brammer, M.J., David, A.S., & Fu, C.H.Y. (in press). Predictors of amygdala activation during the processing of emotional stimuli: A meta-analysis of 385 PET and fMRI studies. *Brain Research Reviews*.

[18] Wright, P., Albarracín, D., Brown, R. D., Li, H., He, G., & Liu, Y. (2008). Dissociated responses in the amygdala and orbitofrontal cortex to bottom-up and top-down components of emotional evaluation. *NeuroImage*, 39, 894-902.

[19] Phan, K.L., Taylor, S.F., Welsh, R.C., Ho, S.-H., Britton, J.C., & Liberzon, I. (2004). Neural correlates of individual ratings of emotional salience: a trial-related fMRI study. *NeuroImage*, 21, 768-780.

[20] Winston, J.S., Strange, B.A., O'Doherty, J., & Dolan, R.J. (2002). Automatic and intentional brain responses during evaluation of trustworthiness of faces. *Nature Neuroscience*, 5, 277-283.

[21] Boly, M., Balteau, E., Schnakers, C., Degueldre, C., Moonen, G., Luxen, A., Phillips, C., Peigneux, P., Maquet, P., & Laureys, S. (2007). Baseline brain activity fluctuations predict somatosensory perception in humans. *PNAS*, 104, 12187-12192.

[22] Vartanian, O., & Goel, V. (2004). Neuroanatomical correlates of aesthetic preference for paintings. *NeuroReport*, 15, 833-837.