

Effect of sound-induced affective states on brain activity during implicit processing of emotional faces

T.Quarto^{1,2,3}, G.Blasi³, L.Fazio³, P.Taurisano³, B.Bogert^{1,2}, B.Gold^{1,2}, A.Bertolino³, E.Brattico^{1,2}

¹*Cognitive Brain Research Unit, Institute of Behavioral Science, University of Helsinki, Finland*

²*Center of Excellence in Interdisciplinary Music Research, University of Jyväskylä, Finland*

³*Dipartimento di Neuroscienze ed Organi di Senso, Università degli studi di Bari "Aldo Moro"*

ABSTRACT

Background

Social interaction involves perception and interpretation of facial expressions (Fusar-Poli et al., 2009), which are vital nonverbal sources of information (Phillips et al., 1995). Our ability to recognize the emotions contained in facial expressions is influenced by our current affective state (Demenescu, 2010). In a behavioural study we demonstrated that music impacts temporary affective state, and that this modified affective state in turn alters the implicit processing of facial emotions. Up to date, no study has revealed the neural substrates of these cross-modal effects of music on visual emotions and affective state.

Aims

We here investigate how affective state induced by noise or music stimulation modulates the brain responses at a precognitive, automatic stage of emotional face processing.

Method

20 healthy subjects underwent functional magnetic resonance imaging (fMRI) while performing an implicit emotion-processing task. In this task, subjects were asked to identify the gender of angry and happy facial expressions while listening to a relaxing music sequence or else while listening to amplitude-modulated noise. fMRI was performed on a GE Signa 3T scanner with a gradient echo-planar imaging sequence (repetition time: 2000 ms; echo time: 28 ms; 26 interleaved slices, thickness: 4 mm, gap: 1 mm; voxel size: 4x4x5 mm; scan repetitions: 180; flip angle: 90°; field of view: 24 cm; matrix: 64x64). A fiber optic response box was used to measure subject response (accuracy and reaction time) for each stimulus. All fMRI data analyses were carried-out using SPM8. Signal change from significant clusters was extracted with Marsbar toolbox and analyzed with StatSoft 8.0.

Results

Behavioral results from Profile of Mood State (POMS) questionnaire demonstrated that the negative and positive sound stimulations significantly modified the affective states of our subjects after each experimental session ($p < 0.001$).

Random-effect models on fMRI data (all $p < 0.001$) revealed a main effect of sound stimulation in bilateral prefrontal cortex (BA47) and a main effect of facial expression in left supplementary motor area and left fusiform gyrus. An interaction between sound stimulation and facial expression was present in right insula. Inspection of brain signal demonstrated that subjects had greater activity in the right

insula during processing of happy faces with music background compared with the other experimental conditions.

Conclusions

Our results indicate that music and noise can alter current affective states, which, in turn, modulate brain activity during implicit processing of facial emotions. In particular, our data suggest that a positive affective context, induced by a relaxing music sequence, may enhance the neural reactivity to happy faces in brain regions strongly involved in the processing and maintenance of reward.

Keywords

Implicit emotion processing, Affective states, Music, fMRI

REFERENCES

- Bouhuys, A. L.; Bloem, G. M. & Groothuis, T. G. (1995), 'Induction of depressed and elated mood by music influences the perception of facial emotional expressions in healthy subjects.', *J Affect Disord* 33(4), 215--226.
- Fusar-Poli, P.; Placentino, A.; Carletti, F.; Landi, P.; Allen, P.; Surguladze, S.; Benedetti, F.; Abbamonte, M.; Gasparotti, R.; Barale, F.; Perez, J.; McGuire, P. & Politi, P. (2009), 'Functional atlas of emotional faces processing: a voxel-based meta-analysis of 105 functional magnetic resonance imaging studies.', *J Psychiatry Neurosci* 34(6), 418--432.