Anuario de Psicología Clínica y de la Salud
Annuary of Clinical and Health Psychology
Year 2013 • Volume 09 • Pages 53 to 56

Departamento de Personalidad, Evaluación y Tratamiento Psicológicos

Reward value of loved familiar faces: an FMRI study

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Abstract:

We have known since decades about the positive influence of social support and positive emotions on health. Different hypothesis have been made in order to understand the relationship between these factors and physiological and psychological indexes of health and wellbeing. One of these hypothesis suggest that secure, caring and loving environments act as safety cues that activates the reward system and inhibits defensive reactions. Previous studies from our lab have shown that viewing loved familiar faces activates the appetitive motivational system and inhibits defensive responses. In these study we compared central activation during the passive viewing of loved familiar faces with the activation associated with other highly rewarding stimuli (attractive faces). Our results show that loved familiar faces provoked a higher activation of the brain reward system, e.g. the medial orbitofrontal cortex.

Keywords: faces, identity recognition, emotion, loved familiar people, fMRI.

Received: 30/06/2013 Accepted: 30/10/2013

Introduction

Social interactions and attachment bonds between humans constitute one of the fundamental sources of pleasure (Berrridge & Kringelbach, 2008). Recently, studies using functional magnetic resonance (fMRI) have shown the involvement of the reward brain system in the processing of loved familiar faces (Bartels & Zeki, 2000, 2004; Aron et al., 2005;). In addition, a sense of being loved, valued and integrated in a social network is related with reduced mortality and morbidity rates (Taylor, 2010; Berkman & Syme, 1979). Regarding physiology, the presence of a loved one is associated with reduced stress responses (Heinrichs, Baumgartner, Kirschbaum & Ehlert, 2003) and lower pain perception (Eisenberger et al., 2011). Previous studies from our lab have shown that the processing of loved familiar faces yields a pattern of peripheral and central responses which is indicative of the activation of the appetitive motivational system (; Guerra et al., 2011) and the reciprocal inhibition of the defense system (). It has been argued that the beneficial effects of social support on health could rely on this reciprocal inhibitory mechanism (Guerra et al., 2012). Nevertheless, the activation of the reward brain system and the subsequent inhibition of defensive responses are also related to the processing of other pleasant stimuli like beautiful faces, erotic-content pictures, and beautiful paintings and music, whose relationship to health outcomes and wellbeing is not so clear (Bradley & Lang, 2007; ; ; Ishizu & Zeki, 2011). In this study we focus on the potential communalities and differences between loved familiar and unknown beautiful faces regarding activation of the reward system.

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Methods

Fifteen participants (7 males) took part in this experiment, consisting of two experimental sessions. In the first experimental session peripheral psychophysiological and subjective emotional responses to the stimuli were recorded. The second session consisted of an fMRI scanning during the passive viewing of emotional faces (loved familiar, beautiful, hated familiar and unpleasant). Four different faces were included in each category. Here we focus on the fMRI data for the contrast *Loved Familiar Faces > Beautiful Unknown Faces (Figure 1)*. The task comprised 180 trials presented in a pseudo-random order: 160 emotional trials (10 for each single picture) and 20 "catch" trials (a picture of a baby taken from the International Affective Picture System) (Lang, Bradley, & Cuthbert, 2008). Pictures were presented during one second with an inter-trial interval between 5 and 6 seconds. Participants were instructed to look at the pictures for the entire time they were on the screen and to press a button whenever the baby picture appeared.

Data from all participants were obtained in a 3T Philips scanner and analyzed using SPM8 (Statistical Parametric Mapping V8 http://www.fil.ion.ucl.ac.uk/spm). Activity in the whole head was measured using an echo-planar imaging sequence that acquired 30 interleaved slices. Acquisition and repetition times were 2.9 and 3 sec., respectively.

Results

Figure 2 depicts main results for the contrast *Loved familiar faces* > *Beautiful faces*. Statistical threshold was set at $p < 0.001$ (uncorrected) with a minimum cluster size of 38. There were six significant activations at the cluster level that can be categorized on a functional level: (a) medial orbitofrontal cortex (MOF) and frontal inferior cortex, (b) supplementary motor area (SMA) and (c) precuneus and fusiform gyrus (bilateral) and right cuneus (see *Table 1*).

Discussion and conclusions

Our results show that the processing of loved familiar faces is accompanied by activation of a set of brain areas associated with the evaluation of their hedonic valence and motivational value, and with identity recognition processes. The brain structures reported here are consistent with data from emotional processing and face recognition studies (Bradley & Lang, 2010; Sabatinelli et al., 2007; Gobbini & Haxby, 20007). Medial orbitofrontal cortex is related to the monitoring, learning and memory of the reward value of reinforces (Kringelbach, 2005), giving support to the hypothesis that loved familiar faces act as stronger reinforces than beautiful faces. The activation found in the supplementary motor cortex could be also explained in terms of a greater emotional response that involves motor preparation and emotional expression (Bradley & Lang, 2010). Finally, the activation found in the cuneus, precuneus and fusiform gyrus might be related to the recovery of semantic and autobiographical memories associated with the familiar face as well as with

Figure 1. An example of a loved familiar face and a beautiful unknown face. Pictures were matched in color, size and background. Faces were chosen with a frontal orientation, direct gaze and a neutral emotional expression.

Figure 2. Activity elicited when participants viewed faces of their beloved ones compared to pleasant (unknown) faces. Abbreviation: SMA = Supplementary Motor Area; MOF = Medial Orbitofrontal.

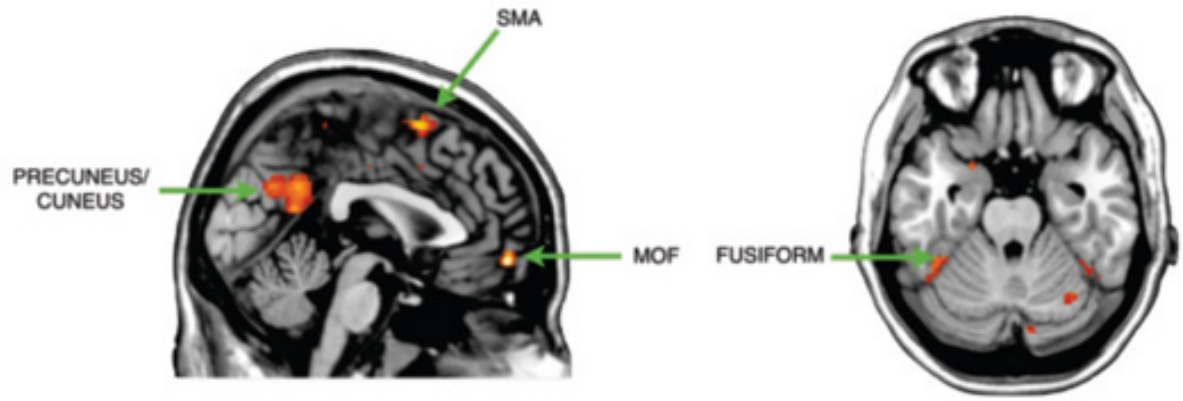

Table 1. MNI coordinates of activations for the contrast Loved familiar faces > Pleasant Faces. Significant activations at P< 0.05 uncorrected.

	Left				Right			
Activations	x	y	z	T	x	y	z	T
Suplementary Motor Cortex					4	10	64	7.00
Medial Orbital Frontal Cortex	0	56	-10	6.71				
Frontal inferior Cortex (Operculum)	-40	8	10	6.56				
Cerebellum	-46	-60	-32	4.39	40	-46	-28	5.58
Precuneus	-4	-54	26	5.42	2	-56	18	5.16
Cuneus	0	-68	30	4.76				
Medial Cingulate	-4	10	40	5.28				
Fusiform gyrus	-38	-44	-22	4.61	-44	-50	-24	4.92

identity recognition processes (Adolphs, 2002; Bartels & Zeki, 2004;). Altogether, these findings show that viewing loved familiar faces activate a set of brain areas related with the processing of emotion and reward, compared with other rewarding stimuli. Understanding how the brain process positive emotions and personal attachment related stimuli can help to developed individual and collective interventions aim at encouraging wellbeing and preventing pathology.

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