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BEAUTY AND UGLINESS IN THE BODIES AND FACES OF OTHERS: AN FMRI STUDY OF PERSON ESTHETIC JUDGEMENT

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Abstract—Whether beauty and ugliness represent two independent judgement categories or, instead, opposite extremes of a single dimension is a matter of debate. In the present 3T-functional Magnetic Resonance Imaging (fMRI) study, 20 participants were scanned while judging faces and nude bodies of people classified as extremely ugly, extremely beautiful, or indifferent. Certain areas, such as the caudate/*nucleus accumbens* (NAcc) and the anterior cingulate cortex (ACC), exhibited a linear relationship across esthetic judgments supporting ugliness as the lowest extreme of a beauty continuum. Other regions, such as basal occipital areas, displayed an inverse pattern, with the highest activations for ugly and the lowest for beautiful ones. Further, several areas were involved alike by both the very beautiful and the very ugly stimuli. Among these, the medial orbitofrontal cortex (mOFC), as well as the posterior and medial portions of the cingulate gyrus. This is interpreted as the activation of neural circuits related to self- vs. other-assessment. Beauty and ugliness in the brain, at least in relation to natural and biologically and socially relevant stimuli (faces and bodies), appear tightly related and non-independent. Finally, neutral stimuli elicited strong and wide activations of the somatosensory and somatomotor systems together with longer reaction times and higher error rates, probably reflecting the difficulty of the human brain to classify someone as indifferent.

Key words: neuroesthetics, beauty, ugliness, fMRI, faces, bodies.

INTRODUCTION

Whether beauty and ugliness make up two independent and discernible pure categories or instead represent opposite extremes of one continuum still remains a philosophical debate (McConnell, 2008). This debate could significantly benefit from the study of brain function. Overall, however, only two previous neuroimaging studies have directly addressed this question including stimuli that could be straightforwardly classified as 'ugly' (Kawabata and Zeki, 2004; Ishizu and Zeki, 2011). In these studies, main areas involved in esthetic judgement exhibited either a linear relationship between their degree of activation and the beauty or ugliness value of a stimulus (namely, medial orbitofrontal- (mOFC) and motor cortices, respectively), neutral stimuli being located in an intermediate position. Other brain regions were similarly activated by both beautiful and ugly relative to neutral stimuli (such as the anterior cingulate- (ACC) or the parietal cortex). Accordingly, brain activity seems to support that beauty and ugliness are not independent esthetic categories, sharing most – if not all – of the involved neural circuitry, whose pieces are activated either similarly or in opposite directions.

In the Ishizu and Zeki (2011) and Kawabata and Zeki (2004) studies the stimuli consisted in paintings or music excerpts. Strikingly, the same stimuli judged as ugly by some subjects were judged as beautiful by others, and vice versa. This might result as problematic for a plain elucidation of whether beauty and ugliness are actually related or independent in the human brain. In this regard, rightful ugliness might not have been compellingly ensured, but rather ambiguous and highly variable across individuals. It appears to us that by using more natural stimuli for which the human brain is importantly and specifically wired, judgements on ugliness or beauty could be more consistent, less subjective, and less prone to cultural and educational factors. The use of natural stimuli that can be judged as extremely ugly or extremely beautiful in a more consistent basis could help to reveal the existence of separated neural circuits for both types of esthetic judgements, if they exist.

Two of these natural stimuli that could accomplish the criteria of being judged as extremely ugly or beautiful are faces and bodies. Human faces and bodies entail biologically and socially significant items, for which ugliness might be expected to be more straightforwardly valued. In this regard, although not impossible, a given body or face would hardly be found to be classified as very ugly by some people and very beautiful by others.

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Abbreviations: ACC, anterior cingulate cortex; BOLD, blood-oxygenated level dependent; DMN, default mode network; fMRI, functional Magnetic Resonance Imaging; FWE, family-wise error; lOFC, lateral orbitofrontal cortex; MNI, Montreal Neurological Institute; mOFC, medial orbitofrontal cortex; NAcc, nucleus accumbens; SMA, supplementary motor area.

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If esthetics is a product of the human brain, and considering that the latter is highly social (or hyper-social) (e.g., Flinn et al., 2005), the evaluation of others' esthetic values appears as a basic building block for beauty and ugliness as meaningful semantic concepts.

Human faces usually classified as 'unattractive' or 'non-beautiful' have been employed in several studies affording the neural basis of the judgement of beauty (e.g., Winston et al., 2007; Chatterjee et al., 2009; for a comprehensive neural model and review, see Ishai, 2008). However, the term 'unattractiveness' is not necessarily synonymous of 'ugliness'; that someone or something is unattractive or non-beautiful can be either an ambiguous categorization, or meaning that it is simply devoid of beauty. This would be the case even if 'neutral' stimuli have also been present. Extreme and unmistakable categories are needed. A similar arguing applies to studies on human bodies in the neuroimaging milieu (for a comprehensive review, see Cacioppo et al., 2008); further, these studies have rather focused on sexual desire and lacked genuinely ugly samples.

The present study included as judged material faces and nude bodies that accomplished the criteria of being categorized as very ugly or very beautiful. This way, we approached the concepts of ugliness and beauty in the human brain in rightly extreme ways and as established on biologically and socially meaningful stimuli. Our approach also involved some degree of abstraction within these concepts, as the esthetic judgements concerned to either bodies or faces indistinctly, as this was unpredictable and not relevant variable for the task. The same applies to the gender of the stimuli. In consequence, particularities specifically related to either facial or body judgements or to sexual attraction would largely be overridden.

Given the particular task and the choice of stimuli used in the present study, several significant factors are expected to be in play, most likely impacting our results. One concerns the emotional dimensions (valence and intensity) presumably elicited by the esthetic evaluation of socially and biologically relevant stimuli. Seeing bodies of others, as well as own body, convey a number of activations related to emotional responses (e.g., Vocks et al., 2010), particularly implying the limbic regions –mainly, the amygdala– as well as other areas related to higher levels of attention. The same principles should apply to faces in our study, as they were equally relevant. Accordingly, we expect limbic activations as main neural mechanisms implied in our study. Limbic responses on the other hand are also expected to vary as a function of the esthetic values of the stimuli. Both beauty and ugliness are known to trigger highly intense emotions (Rawlings, 2003; Silvia, 2005) and though in a first glance they might represent positive and negative valences, respectively (see, e.g., Jacobsen et al., 2004), this is however not necessarily always the case, as there may be fascination with ugliness, i.e., deformation, grotesque, morbid, etc. (e.g., Eco, 2007, Rawlings, 2003). The classic assumption that activations of the amygdala relate solely to negative emotions seems no longer tenable (e.g., Winston et al., 2007), and therefore it is possible that this structure might not importantly contribute to our data. Nevertheless, other regions most usually associated with identifiable emotional valences, such as the *nucleus accumbens* (NAcc) for positive emotions (e.g., Sabatinelli et al., 2007) might help to better define and differentiate the valence of the emotions elicited by our stimuli.

Tightly linked to the emotional, social, and biological features commented above, an important portion of our brain activations could also relate to self-referential (normally referring to an external –or others'– viewpoint; see Pöppel et al., 2013) and self-related (internal viewpoint) processing as main mechanisms involved in the evaluation of others (Northoff et al., 2006; Pöppel et al., 2013). Evaluating others seems to imply the continuous involvement of self-referential and self-related systems located in the medial cortex of the brain, such as the ventromedial prefrontal cortex or the precuneus. Indeed, this might be a main difference between ours and other studies on esthetics, since evaluating body parts elicit different brain activations as a function of the type of representation: realistic pictures activate the precuneus, contrasting with unrealistic representations (Silveira et al., 2012), whereas photographs, but not paintings, of body parts activate ventromedial prefrontal regions including the mOFC (Lutz et al., 2013). Indeed, self-referential and self-related information seems to be continuously and automatically involved when evaluating the value of others (Li and Kenrick, 2006). It might be therefore that both the extremely ugly and the extremely beautiful stimuli in our study activate these medial regions similarly, a consequence of the strong involvement of self- vs. others- referential systems expected in our task.

Finally, and again highly related with the argumentations above, it appears expectable the involvement of the default mode network (DMN) in our study. The DMN, which conveys some of the medial cortex areas mentioned earlier (Buckner et al., 2008), is not only significantly activated during esthetic appraisal (Vessel et al., 2012; Vartanian and Skov, 2014) but also, and importantly here, in processes related with empathy (Farrow et al., 2001), theory of mind (Mars et al., 2012), and self/other distinction (Ruby and Decety, 2004). Accordingly, we expect to find the implication of the DMN in our study, as the task demands others' evaluation while presumably involving self-referential and self-related systems.

EXPERIMENTAL PROCEDURES

Subjects

Twenty, right-handed (average handedness score of +75; Oldfield, 1971) healthy subjects (10 females) participated in the study (mean age = 21.3; SD = 3.9). They were undergraduate students, with corrected-to-normal vision, and with no history of neurological or psychiatric complaint, as declared by the participants. All the subjects declared to be heterosexual. Informed consent to participate in the study was obtained from all the subjects, who were reimbursed for their cooperation. The study was accomplished according to the Declaration of Helsinki,