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Neuropsychological Response to Information of Beauty/ Ugly Brain Circuits According to the Informational Model of Consciousness

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Abstract: The analysis of some experimental data obtained by functional magnetic resonance imaging and positron emission tomography of the activity of brain as a neuropsychological response to the concepts of beauty/ugly by visual and auditory signals and to the Beauty-is-Good stereotype, revealed unsolved problems concerning: (i) the implication of the medial orbito-frontal cortex as a judgement center only in the beauty signals, while the ugliness signals activate amygdala but not medial orbito-frontal cortex; (ii) the caudate nucleus is activate only as a response to the beauty concept in visual operations and not in musical ones; (iii) the reactive neuropsychological response of medial orbito-frontal cortex acts in an opposite manner in comparison with that of insula in the Beauty-is-Good stereotype. Approaching these results according to the informational concepts of the informational model of consciousness, it is shown that the neuropsychological response to beauty concepts as friendly signals are operated by the memory-decision circuit voluntary controlled for a rapid adaptation to reality, while the ugliness concepts are automatically detected as potentially dangerous signals by amygdala, ancestrally prepared to trigger the alarm circuits. The other revealed problems are solved in informational terms also, highlighting the priority of the visual activity in the human cortex in comparison with auditory signals and the vigilance activity of insula, ancestrally prepared to be involved in the detection of the external dangerous signals.

Keywords: Neuropsychological response; Beauty/ugly concepts; Visual and auditory signals; Informational model of consciousness; Problem solving

Introduction

Beauty is a gift eulogized by poets and artists, but also sought and admired by each of us every day. We admire it in the flowery gardens, in the green nature, in the blue of the sea and sky, in everything that surrounds us and brings us the wonderful feeling of satisfaction. We admire people's beauty both physically and mentally. No wonder, then, that neuroscience aims to study beauty in terms of brain functions. [1–5]. These refer to neural correlation [1], to correlation with aesthetic preferences for painting [2], with classical and renaissance sculptures [3], pleasant and unpleasant music [4] and aesthetic and moral judgments [5]. On the other hand, the remarkable advances in approaching and explaining the functionality of the brain from the information point of view, have allowed to solve some older and widely debated problems in philosophy, neurosciences, neurology, geriatrics, neuropsychology and behavioral sciences, like the role of information in the brain functions [6,7] and in the human body [8,9], the relation of the mind with the body [10], the intervention of information in living systems [8,11], the intimate mechanisms of informational communication in the human body [12], the connection to some extrasensory phenomena [13,14], the definition of attitude [15] and its quantitative evaluation [16], music-assisted neurological rehabilitation [17], cognitive-informational therapy in mood disorders [18,19].

These successes allow to approach now from the informational point of view an issue of wide interest, i.e. beauty and its informational antipode – ugliness, and the neuropsychological response to information of the corresponding informational circuits in the brain.

Analysis of the Neural Response to Beauty/Ugly Informational Concepts

The contribution of non-invasive and non-destructive investigation methods such as functional magnetic resonance imaging (fMRI) has been and remains fundamental in observing the functionality of the brain to various stimuli of different nature, mainly to visual and auditory information. In one of such studies [1], there were observed the brain areas specifically engaged in the reaction of subjects when they viewed paintings which they considered beautiful or ugly, independently on the represented image, either portrait, landscape, a still life, or an abstract composition. The main results show that the stimulated area of the brain is the medial orbito-frontal cortex (mOFC) when the image is considered to be beauty, regardless of the category of painting, and surprisingly, when the image is considered to be ugly, the motor cortex is also activated, specifically the somatosensory cortex and supramarginal cortex [21]. These two regions of the brain are represented in Figure 1, left bottom side.

The aesthetic preference in the assessment of attractiveness in faces [2] shows that the main activity is registered in mOFC (represented in the left upper side in Figure 1), and also in nucleus accumbens, caudate nucleus. Specifically, in a more recent similar study [20], it was shown that: (A) if the response of subjects is of the form Visually Beautiful > Visually Ugly, then the activated zones of the brain are mOFC and caudate nucleus (active also in romantic love); (B) if the response is Visually Beautiful > Indifferent + Ugly, then the activated zones are mOFC and caudate nucleus; (C) if the response is Visually Beautiful > Indifferent, then is activated only mOFC; (D) if Visually Ugly > Indifferent, the activated zone is only amygdala. Particularly, the activation in caudate nucleus decreased in response to decreasing preference [2].

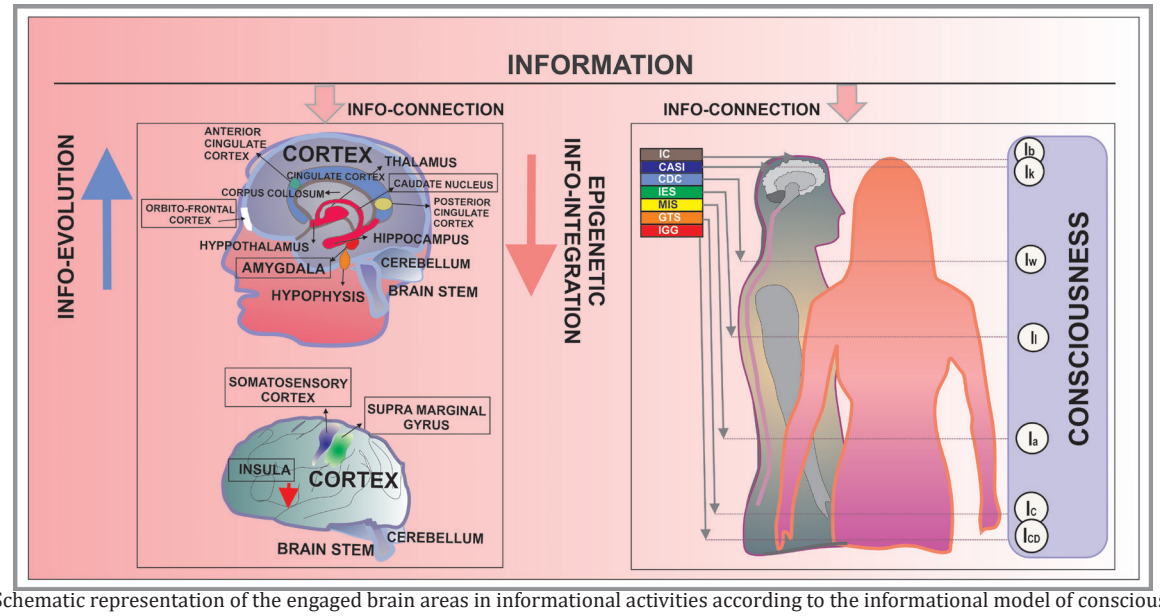

Figure 1: Schematic representation of the engaged brain areas in informational activities according to the informational model of consciousness and beauty/ugly reactions.

In a study dedicated to the brain response to beautiful or ugly music, measured by positron emission tomography (PET) to examine cerebral blood flow changes [4], it was deduced that there were observed distinct paralimbic and neocortical regions as a function of dissonance and of perceived pleasantness/unpleasantness. More specifically, in a more recent comparative study it was shown that: (E) if Musically Beautiful > Musically Ugly, then it is activated the mOFC; (F) if Musically Beautiful > Indifferent + Ugly, then it is activated the mOFC; (G) if Musically Beautiful > Indifferent, then mOFC was activated; (H) if Musically Ugly > Indifferent, it was activated the supramarginal gyrus, as it is shown in Figure 1 left bottom side. The supramarginal gyrus forms with other brain structures a multimodal complex that receives somatosensory, visual, and auditory inputs from the brain and plays a role in phonological processing (i.e. of spoken and written language) and emotional responses [21].

Moreover, a very important conclusion was that the strength of activation of mOFC is proportional to the strength of the declared intensity of the beauty experience [20], as far as activity in the brain is concerned, independently of the beauty source, either visual or musical one, and probably of other sources as well. The only common area activated both in music and visual experiments is mOFC.

From the above study the following not understood problems were derived: (1) as the mOFC is currently involved also in judgment, either in beauty and ugly, it is not clear why this region is inactive as the response to ugly (the experience of ugliness was confined to the amygdala and left somato-motor cortex, according to the results (D) and (H)); (2) the caudate activity is evident only during the experience of visual beauty, and not in musical beauty.

An interesting fMRI investigation on this issue was carried out to determine the validity of the "Beauty-is-Good" stereotype [5]. This stereotype, largely spread among popular beliefs, refers to the fact that the attractiveness of beauty can include also the goodness quality, consisting in high moral standards and desirable personality. The main results of this study indicates the following: (i) the activity was increased both for beauty and goodness in mOFC; (ii) the activity was decreased in insula both for attractiveness and goodness; (iii) an opposite contrasting relation between the activity of mOFC and insula cortex (related to the threat [22]) as aesthetic and moral judgment is concerned. Insula is a small region of cortex within the lateral fissure which separates the frontal and parietal lobes from the temporal lobe [22], according to the Figure 1 left bottom side. The behavior described in the items (i) – (iii) is still not understood.

Beauty/Ugly Brain Circuits According to the Informational Model of Consciousness

The previous experimental results are discussed in this chapter from the perspective of the Informational Model of Consciousness (IMC) from two points of view: (i) the assessment of the characteristic functions of the cited zones of the brain from the informational perspective and their assignment of an appropriate informational circuit and associated

cognitive center; (ii) the discussion from informational perspective of not understood problems resulted from the experimental studies, and finding of adequate solutions.

In Figure 1 right side it is represented schematically the informational system of the human body, acting as specific informational systems with specific distinct, but inter-correlated functions: CASI (center of acquisition and storing of information) is connected with external and internal sensors, with prefrontal cortex (short-term current memory), with hippocampus (long-term memory) and cerebellum (learned abilities), and is reflected in consciousness as the cognitive center Iknow (abbreviated as Ik); CDC (center of decision and command) is decision making info-operator and motor commander, connected with CASI and execution elements of the body, with cortex and particularly with prefrontal cortex/mOFC for judgment processes, reflected in consciousness as Iwant (Iw); IES (info-emotional center) manages the emotions and is connected with limbic system, particularly with amygdala (alarm operator), reflected in consciousness as Ilove (Il); MIS (maintenance informational system) manages the metabolic processes and is mainly connected with the brain stem, thalamus and hypothalamus, and is reflected in consciousness as Iam (Ia), the center of power and health status; GTS (genetic transmission center) is responsible of genetic transmission, connected with hypophysis; IGG (info-genetic generator) manages the development of the body according to the age, is related by the activity of hypophysis too, and is reflected in consciousness by the inherited qualities and behavior expressed in the center Icreated (Icd); IC (info-connection) pole manages the acceptance/rejection selection of information to prefrontal cortex, particularly to mOFC, is related by the activities of the anterior and posterior cingulate cortex [23-25], and is reflected in consciousness as the cognitive center Ibelieve (Ib).

From the above description results that mOFC is the judgment area of the brain, responsible for the decision and belongs to CDC. However, the CDC is closely related with CASI not only because CASI is the source of information for CDC, hut also from anatomic point of view, because they benefit of a common or very close area of activity, which is the prefrontal cortex. Therefore, this area is practically the basic zone of awareness.

The informational circuit of beauty can be therefore included in the CASI-CDC circuit. The functionality of CDC is based and consists in processing of information received by means of CASI, both directly by the connection with reality, or indirectly, by exploring the internal resources – memory. Therefore, if the assessment of beauty is actually a judgement process, this process is operated taking into account the personal criteria of judgement. These criteria are acquired especially during the first years of childhood, when especially the family, but also the environmental conditions, determine the children behavior and mentality.

Specific inherited characteristics are also manifested as judgement criteria, so the assessment of the concept of beauty is relative and specific for every individual. The cognitive center Icd is therefore deeply involved in the beauty appreciation by means of the inherited and acquired judgement criteria stored in memory (Ik), delivered also with the intervention YES/NO of the info-selector, which is Ib. The beliefs are practically the most strong part of criteria field of information, by field of information understanding the distinct information distributed into the memory brain zones. Beliefs are part of mentality, strongly representing the cultural, religious, and social attributes of the community from which the individual comes from. The judgment criteria depends also on the life experience, stored in memory (Ik). Independently on such criteria, the activation of mOPC occurs when individual expresses his/her option YES or NOT, as a confirmation or rejection of the beauty.

The emotional system intervenes also in the decision, according to the info-emotional experience accumulated in memory. CASI is closely related not only with CDC, but also with IES/Il, not only because the emotions and emotional states are also stored in memory, but also because the anatomic component – hippocampus, belongs to CASI and limbic (emotional) system. As beauty is also related with the emotional (IES/Il) and romantic love, GTS/Ic can be an active contributor to the beauty assessment. Actually, the assessment of beauty involves a desire, so is represented practically by CDC/Iw.

The unsolved problems (1) – (2) derived from the beauty/ugly experiments highlighted above can be analyzed therefore as below.

a. The beauty is a concept which can be discussed as a part of a judgement process for adaptive/reactive neuropsychological response to an input information. Such a process is conscious, and is operated by using decision criteria according to a Good/Bad (YES/NO) selective experience. This experience is acquired during the lifespan by integration of information into the genetic system, without change of the species genetic codes, on the basis of epigenetic processes [26]. The integration process is schematically represented in Figure 1 left upper side by the down arrow. Indeed, the integration of information starts with the reception of an insistent and/or repetitive information in CASI/Ik, which then is operated in CDC/Iw. The participation of emotions (IES/Il) amplifies the integration process, as a concomitant body reaction to the reception of information. In a subsequent step of integration, the information is converted in an automatic MIS-type stereotype/ability and included finally in GTS/Ic by epigenetic mechanisms, transferred then to IGG/Icd of the next generation. The intensity of the initial/repetitive signal determines the intensity of brain activation, as it was demonstrated in the experiments presented above, supporting the described mechanism of the info-integration process. Such a process has been allowing the evolution of the human species and of the brain [24], as it is schematically suggested in the left side of Figure 1 by the up arrow. The alarm is one of the fundamental component of the body existing at any species, even for species with inferior organization on the evolutionary scale. This is necessary in order to assure the organism defense. Therefore, at human, a detected signal interpreted as dangerous, triggers automatically the alarm reaction of the brain/body when ugly is perceived, and determines the activation of amygdala and motor-defense system. As a consequence, while assessment of beauty is a controlled/judged process in the CASI/CDC circuit with observed activation of mOFC, the assessment of ugly is deviated automatically to IES/danger neuropsychological reaction, activating the defense mechanisms of the body. The beauty/ugly circuits appear therefore as two distinct operational lines: the beauty circuit is CASI-CDC based on judgement, while the ugly circuit operates as automatic IES-CDC defensive neuropsychological reaction of the brain/body against a potential danger, as a reflex neuropsychological ancestral reaction inherited by species.

b. The second problem could be explained also by the evolution of the human species. Indeed, at present, more than 50% from the cortex surface is engaged in the visual info-processing [27]. Therefore, the most active/sensitive part of the info-reception of the informational system of the human body under connection with environment is the visual reception, so this is priority in the assessment of reality, activating the voluntary CASI-CDC circuit of judgement. As the caudate nucleus is activated also in romantic love, we have to deduce that the beauty circuit interacts also with GTS/Ic system/cognitive center, predominant for procreation of species, inducing the activation of the caudate nucleus as an associated/partnership structure.

The problem derived from the Beauty-Goodness stereotype reaction described in the items (i) – (iii), can be explained as follows. Beauty and Goodness are attributes judged/analyzed by CDC in correlation with CASI, activating mOFC zone of the brain. The attractiveness and/or goodness attributes are friendly (not dangerous) signals for the brain, ancestrally accepted [28]. However, as insula is involved (among other tasks [22]), in the detection of dangerous/threat signals, the vigilance activity of this zone is decreased during the reception of acceptable (beauty, goodness) friendly signals, in opposition with the increasing activity in mOFC.

Conclusion

On the basis of the analysis of some experimental data with fMRI and PET, revealing the activation of certain zones of the brain as a neuropsychological reaction to concepts of beauty/ugly and of Beauty-is-Good stereotype, it was observed that not yet understood problems arised from these data. With the aim to solve these problems, the brain neuropsychological reaction to beauty/ugly concepts was described in terms of information, according to the informational model of consciousness, showing that:

I. the mOFC is activated only as a response to beauty, which is a friendly signal in the CASI-CDC informational circuit, voluntary controlled for suitable/rapid adaptation to reality, while ugliness concept activates primarily/automatically amygdala in the informational IES-CDC circuit, as an ancestral aversive reaction to a potential danger, for body defense;

II. the caudate nucleus is activate only as a response to the beauty concept in visual operation and not in musical one, because according to the development evolution of the brain, the visual activity is priority and more sensitive in the interaction with reality, occupying more than 50% from the cortex area, and is associated with the activity of caudate nucleus as a traditional partner involved in the romantic love powerful circuit, dedicated to reproduction.

The opposite neuropsychological reactive response of mOFC in comparison with that of insula in the Beauty-is-Good stereotype, is due to the friendly accepted concept of attractiveness and goodness in the voluntarily controlled CASI-CDC circuit, in detriment of the vigilance activity of insula, ancestrally prepared to detect the threat/punishment dangerous signals.

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Conflict of Interest

The author has no conflict of interest.

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