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Biology of Aesthetics

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Sensing Beauty

Somewhere along our evolutionary path, the human lineage developed an obsession with beauty in sounds and objects. The clue to understand the biology behind this phenomenon lies in a dictionary definition of beauty: "A quality that gives pleasure to the mind." Humans are equipped with several types of senses, but only the two based on eyes and ears transmit signals associated with aesthetics. Thus, the pertinent question when it comes to understanding the biology of aesthetics is "Why are certain visual and auditory stimuli processed in a way that gives us pleasure?" The brain receives a continuous flow of sensory information. Most signals are neutral, some may be repulsive, but a considerable variety of signals have the potential of eliciting some sort of pleasure. The term aesthetics, however, is generally limited to stimuli derived from sounds or objects produced with the aim of eliciting a positive experience. In other words, aesthetics is about man-made creations that offer pleasure based on our auditory and visual senses. Evolution did not give us eyes and ears for the purpose of idle pleasures. They are part of a survival kit. Looking at a painting or listening to music is unlikely to help you survive, yet people spend a fair amount of time doing just that. This entry tries to explain why.

The Many Components of Art

A concern for aesthetics appears to be a universal feature among human cultures, strongly suggesting that there are innate mechanisms behind. The evolutionary perspective may, therefore, help explain why we care about beauty, and, possibly, suggest what aspects of music and art that tingle our brain in a way that causes satisfaction.

First, one needs to dissect what art is about, that is, to distinguish between aesthetic elements and other aspects. Aesthetics serves several cultural functions, such as communication with God, and influencing people's political ideas. Moreover, art has obvious economic aspects, not just in the value of pieces of art, but also in the use of aesthetics to sell products. Another highly relevant feature is the potential that art has in offering status to those with relevant skills – a point that is particularly relevant when it comes to attracting a mate.

Another way of dissecting art is to distinguish between pure aesthetic elements and experiences based on the associative content; for example, a love song may stimulate some of the positive feelings involved in love, and a painting of a baby may warm the heart of adults.

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This entry focuses on the elements that add what may be referred to as *aesthetic value*. It is assumed that these elements operate independent of cultural implications and associations involved. This statement is backed by the observation that people tend to agree upon what is good, or not so good, in art derived from different cultures. It implies that there are vaguely definable aesthetic rules, employed by the artists, which add a particular artistic quality. These rules, or elements, are what we look for when distinguishing between a bowl with solely functional value and a bowl with added aesthetic value; or cherished music compared to just noise. While many aspects of art depend on particular individual or cultural parameters, the underlying aesthetic elements appear to rely on innate features of the human mind. These more intuitive elements are not necessarily the most important, but they are the focus of this entry. Other aspects of art, not the least its function in mate choice, have obvious biological implications, but they are considered less relevant when discussing aesthetics.

Brain Rewards

The intuitive aesthetic elements is a question of what sort of visual or auditory signals that are likely to be processed by the brain in a way that gives the observer a positive feeling. In order to appreciate this perspective, it is important to have a basal understanding of why the brain offers positive and negative experiences. As a general rule, feelings serve one of two functions: they either encourage or discourage particular types of behavior. Food taste good, so you eat. It hurts to burn your finger, so you avoid fire. In other words, feelings tend to come in two flavors: positive or negative. This is, of course, a simplified version of reality. In many instances, the value is less obvious and quite often it depends on the situation. Some people enjoy the thrill of a dangerous task, such as climbing a mountain, while others consider it a totally unpleasant affair. Still this bipolar view of brain instigation is useful for the present purpose. Thus, I shall use the terms brain rewards and brain punishments to signify sensations experienced as respectively positive and negative. Some further comments are called for. Employing your brain or body to do what they are designed for is generally positive, in the sense that it is good for your genes, and therefore, connected with rewards. This implies that even sadness may "feel good" because it is a reaction that under certain circumstances serves you well. Signs of sadness may, for example, elicit help from others. Several Hollywood productions testify to the potential value of sorrow – people flock to movies that make them cry. Another important point to note is that reward-type mechanisms for directing behavior are not necessarily adaptive in the situation we live in at present. The reward of an orgasm feels good regardless of contraceptives. For the genes, unproductive sex can be seen as a waste of time, but the genes did not foresee the invention of contraceptives. Likewise, adding aesthetic value to an object or a work of art does not necessarily give any evolutionary advantage. The essential feature of aesthetics is to evoke feelings perceived as positive. The feelings do not need to be cheerful, neither is any engagement in art necessarily adaptive. The brain offers "rewards" because directing your attention to particular types of sensory input was adaptive at some point in our evolutionary history.

Visual Aesthetics

Our ancestors began to walk upright some 3–4 million years ago, thereby freeing their hands for more advanced manipulation of tools. Tools can be of obvious importance for survival, the surprising part is that at some point people started to add beauty to the objects. Today we have moved one step further: We create objects of art with no apparent practical value. The first obvious signs of this propensity, in the form of cave paintings and the production of figurines, date back some 40,000 years. However, archaeologists have discovered signs of similar behavior at least 100, 000 years ago, in the form of presumed shell necklaces and the use of

Au1 pigments. Most likely artistic behavior goes back much further, but the evidence is long lasting. In fact, even chimpanzees appear to take delight in producing art – which is not surprising, as the aesthetic elements to be discussed below presumably have a long evolutionary history.

Elements of Visual Aesthetics

Balance and Symmetry

One of the few rules of aesthetics that has won a certain acceptance is the principle stating that the main motif in a picture should divide the canvas in a ratio of approximately 3:5. What the principle suggests is that placing an object in the middle is boring, while placing it too far to one side produces an unbalanced appearance. The ratio of 3:5 is supposedly the optimal compromise between these two undesirables. The disagreeable effect of the unbalanced picture is possibly connected with our fear of falling. Falling is not a common problem for an animal stationed on the ground, but our ancestors did at one point live in trees. Furthermore, even ground-dwelling animals would be conscious of the possibility that an unbalanced rock may roll. A dominant object on one side of a picture gives the unpleasant impression that this side is tilting unless a balance is added on the opposite side. On the other hand, we tend to cherish a bit of excitement. Thus, the choice is much a question of what sort of subconscious feelings the artist aims for: thrill or calmness. Both offer possible brain rewards.

In some cases, an exact balance may add particular value. Symmetry is appreciated. Perfect symmetry in a person's anatomy, or in a prey animal, is a sign of gene quality, which is to be desired. The positive value of symmetry in connection with aesthetics is most obvious in architecture. Many buildings considered to be great works of art have symmetrical features.

Color

Many plants offer nourishment to animals in exchange for helping their seeds. Tomatoes, for example, are meant to be eaten – the perfect start for the seeds of this plant is to end up in feces. In order to signal that the fruit is ready to be eaten, a conspicuous color is usually added. Animals have evolved the ability to respond accordingly. They have a visual system enabling them to spot ripe fruit. Fruits and berries are important for human sustenance. To induce us to find them, we presumably developed appropriate brain rewards, that is, an appreciation of colorful objects that contrast with the surroundings. I believe these rewards constitute an element in the biology of aesthetics. In line with this notion, we do indeed appear to prefer warm colors, such as red or yellow – particularly as opposed to brown. Ripe fruit is typically red or yellow, while feces, a substance to be avoided, are brown. Colors that are light and fresh tend to be considered pleasant while darker, and muddier, colors, particularly brownish or grayish, tend to be depressing. Humans thrive in daylight. However, as pointed out above, even sadness can be conceived as a positive sensation. Thus, the artist may very well create a great painting using dark brown rather than brilliant red.

Curiosity and Attention

Some animals are specialists. Cows, for example, concentrate their attention on a limited range of visual impressions, such as the quality of grass. Humans are quite the opposite. We are specialists in nonspecializing. We are stimulus-hungry and have an inclination to gather all sorts of information from our surroundings. Survival often depends on careful observation, such as finding the way, gathering food, and recognizing faces. Exploratory behavior is, therefore, connected with brain rewards. The term "boring" is used in aesthetics when there is not sufficient variation or novelty in a work of art. The object lacks sufficient detail to attract attention. On the other hand, complexity stimulates our curiosity and is, therefore, pleasing. A too complex visual input may, however, prove adverse. The mind needs to find clues that can help it organize the details. Thus, there should be a unity in the diversity. In the aesthetic tradition of the Chinese, there is a concept called "The rule of five," referring to the limitations of the human attention span:

The mind can without too much effort grasp five elements at a time. If too many unconnected elements are added, the impact may be stressful. As a rule of thumb, the complexity should not move beyond the attention potential of the human brain.

Depth and Movement

Binocular vision is typical for primates. This feature is probably connected with the visual requirements of living in trees. Moving from branch to branch demands an accurate ability to measure distances. In order to take full advantage of the various potentials of the brain, we need practice. Children are encouraged to practice by participating in play activities. The purpose of play is to learn tasks that the brain has a rudimentary potential for performing, but which yet require further training. The brain rewards us for developing our potentials. Our ability to measure depth and calculate movements requires practice. We may, therefore, be rewarded for processing visual input relevant to this task. A typical criticism of amateur paintings is that they appear flat. We appreciate a painter who manages to create the perception of depth. It is possible to lure the brain into perceiving motion by adding dots of different colors, but the same light intensity. Furthermore, a picture may contain lines that the eyes are induced to follow, and thus offer the viewer a sense of movement.

Functionality

The idea that the functional is also visually attractive was particularly influential on architecture in the 1930s. A central doctrine then was that form should follow function. A related idea is that art should try to perfect nature. Beauty has been described as a "comprehensible representation of the perfect." There are obvious reasons why looking for functionality and perfection should be connected with a reward. Consuming rotten food may be dangerous, whereas eating the best specimens keeps you healthy. Moreover, it is important to recognize the functional qualities of tools. Receiving a pleasant sensation when viewing the right objects helps the individual to distinguish good from bad, and stimulates us to try to obtain the better items.

Art as Hedonism

The above list of elements is not necessarily exhaustive. The focus has been on presenting a way of understanding aesthetics. The list includes what I believe to be the more important factors. Our visual system, including the accompanying reward mechanisms, was developed for viewing nature, not artificial objects. The attributes of our vision, as well as the characteristics of nature, may guide us in an attempt to find and utilize aesthetic elements. Obviously, there are numerous ways of eliciting rewards. Thus, the theory presented here does not restrict the artist to narrow rules. The present understanding of aesthetics is related to a dominant philosophy of art sometimes referred to as the *hedonist school*. Its central idea is that aesthetics is about creating images that induce pleasure. The biological model adds substance to this theory. It agrees with the central notion, but by using the word "pleasure" in a broader sense, the model helps resolve a paradox of the hedonist school: Why so many of the great works of art reflect sadness and tragedy? As explained above, the feeling of sadness is not necessarily negative.

Auditory Aesthetics

Music can arouse a surprisingly intense emotional response. The biological approach to understanding the human mind may offer an explanation. Again, the answer depends on insight into why certain sensory stimuli are processed in a way that engaged reward-type nervous circuits. Although musical appreciation is clearly influenced by nurture, several arguments favor the notion that the appreciation of music is an innate trait. One line of evidence for a genetic influence is the universality of musical appreciation. Most cultures make use of music, if not with advanced instruments, in the form of song and rhythm. Playable flutes that are almost

9,000 years old have been found in China, and a piece of bone discovered at a Neanderthal site had holes drilled into the hollow part, suggesting that even they made flutes. The observation that musical appreciation apparently arises spontaneously in children offers further evidence and so does the powerful effect music has on the human mind. The Neanderthal lineage diverged from the lineage leading to present-day humans more than half a million years ago. Thus, the ability to appreciate music may have been present in hominids for a long time.

The Language Connection

Accepting that our passion for music is based on an innate tendency, the question is: Why is the human brain designed to connect certain forms of auditory signals with pleasurable sensations? In other words, what sort of evolutionary forces carved this tendency into the human mind? Oral language is the most obvious advantage associated with complex sounds. A possible evolutionary connection between language and music has been discussed by several authors, starting with Darwin in his "Descent of Man." I shall expand on this connection, in an attempt to develop a coherent theory for the evolution of musical appreciation. The language connection is the pivotal element, but other forces are presumably also involved.The way human infants learn language is different from the way birds learn to vocalize. The sound-producing capacity of most birds tends to be fixed. Some are able to learn by imitation and to elaborate on themes, thus creating both dialects and individual signatures, but their song is mainly hard-wired. Humans are born with an innate capacity for language, but this is only a template; extensive practice is required in order to learn to produce and decipher language. Physical play is necessary for infants to develop the nerve circuitry required for muscular coordination. Focusing the mind on the production and interpretation of sounds is presumably adaptive behavior because it helps develop the nerve circuitry required for language. As such, this activity should be coupled with positive sensations. According to this hypothesis, our appreciation for music was designed by evolution primarily in order to improve brain structures involved in language. It might be argued that the hypothesis would predict that a preoccupation with music, as with other play behavior, should be associated with children. In response to that, it may be noted that even when the main circuitry has been established, the mind presumably continues to pay attention to sounds for two reasons: Firstly, as adults we may still need to exercise our sound-producing and interpreting capacity. Secondly, we are stimulated not just to improve our senses, but also to use them in exploratory behavior. Exploratory behavior, that is, taking an interest in our surroundings, may decrease upon ageing, but does not disappear. The concept of agreeable sensations designed for the purpose of improving the capacity for oral communication, as well as for stimulating an interest in sounds, can explain it; but then why are not all sounds equally pleasing? A further analysis is required to understand why we distinguish between noise and music – that is, we need to describe the features that cause auditory signals to be pleasing.

Elements of Auditory Aesthetics

Complexity and Coherence

As in the case of visual art, a certain complexity of sounds presumably has a positive effect on the listener. A single, pure tone is not that interesting to explore. A measure of intricacy is required to excite human curiosity. Sounds that are too complex, however, tend to be overwhelming. We presumably prefer some sort of coherence, that is, a principle that connects the various sounds and make them comprehensible.

Purity and Harmony

The tendency to prefer pure sounds is a central element in the enjoyment of music, and a possible consequence of the language connection. The preference for purity and consonance appears to be innate. One reason why these qualities are favored may be because they enhance oral communication. The capacity to produce pure sounds

is most advanced in animals in which auditory signals are the prominent form of communication, such as songbirds and whales. A pure tone presumably carries further, and although language typically includes a mixture of relatively pure (vowels) and dissonant (consonants) sounds, harmony is expected to reduce ambiguity. The brain centers involved in the production and processing of sounds are probably predisposed to prefer sounds with suitable qualities. Some languages are referred to as tone languages; that is, the meaning of a particular sound depends on the pitch. Speakers of these languages appear to be more able to recognize variations in pitch compared to speakers of non-tonal languages. It is conceivable that the first human languages were more like song, or at least depended on pitch, which would lead to an augmented interest in this aspect of sounds.

Temporal Patterning and the Human Touch

A main feature of human language, as opposed to oral communication in apes, is the importance of the temporal patterning of sounds. Single sounds are in most cases not sufficient to convey meaning, whereas when put together in a sequence they form words and sentences. Temporal patterning is equally important in music – if the tones are not in some way tied together sequentially, people are unlikely to show appreciation. The temporal patterning is related to what the musical literature refers to as melody. It is conceivable that music requires similarities to language, such as complexity and melody, in order to be valued, because only then does it utilize the brain resources involved in processing spoken words. Another element in the appreciation of sounds, as in visual arts, is the communicative aspect. Humans seek to gain knowledge about other individuals as part of our social nature. When a person creates sounds, we tend to search for a message, or at least we expect that something about that person's emotional life can be inferred. A voice satisfies this criterion, the same goes for an instrument in the hands of a skilled musician, while it is difficult to program a computer to display emotion. In other words, the complexity should have a human flavor. It is interesting to note that people tend to agree, at least to some extent, on what emotions a given sequence of music reflects.

Safe and Relaxing Sounds

The appreciation of music depends on a variety of qualities of sounds, the language connection does not necessarily explain them all. Music can have a relaxing effect not only on humans, but on animals as well. One possible explanation for the relaxing effect is that music is continuous and rhythmical. In a natural environment, danger tends to be accompanied by sudden, unexpected sounds. A background of constant noise suggests peaceful conditions; discontinuous sounds demand more attention. Even soft discontinuous sounds that we consciously realize do not signal danger can be disturbing, for example, the dripping of a leaky tap. A continuous sound, particularly one that is judged to be safe, relaxes the brain. As to the soothing effect on humans, it may also be pointed out that music presumably is intuitively understood to be man-made, and as such normally not related to dangerous situations.

Rhythm

One of the most characteristic features of music is rhythm. In tribal music, rhythm instruments are often the main element, but even elaborate music seems to require rhythm in order to be appreciated. The rare cases of experimental music without a beat have, as expected, not enjoyed commercial success. Rhythm is probably appreciated because it helps us organize the sound, and because it is a comforting feature. The comfort can be related to the absence of danger associated with rhythmic sounds, but also to a resemblance to the pulse of the mother's heart imprinted prenatally. Newborns appreciate sound in the form of voices, vocal music, or heartbeats.

The Chill

The above suggestions may explain a general appreciation for music, yet the emotional response is sometimes more overwhelming than what would be anticipated. Particular passages

can generate an intense pleasurable experience described as a chill or a thrill. It is not an expected evolutionary strategy to encourage a certain type of behavior in excess of what is adaptive. A person who is preoccupied with song or music pays less attention to other tasks or to possible dangers. For example, if you are engrossed in singing you are unlikely to detect an approaching predator. Thus the rewards associated with sounds should not divert our attention to a greater extent than what the contribution to survival suggests. The chill appears to be excessive encouragement. Certain qualities of music that tend to produce chills point toward a possible explanation. Research suggests that chills are evoked more often by sad music than by happy music, by familiar music rather than an unknown piece, and intense passages, such as crescendos, are particularly chilling. Chills are more commonly experienced by women than by men. It is conceivable that chills hook directly onto the brain's primitive emotional circuits; more specifically, that music has some sort of relationship with the call of an infant crying for its mother. Separation calls are expected to evoke powerful feelings in parents – especially in mothers. Human separation calls have properties related to chill-producing sounds: the cry of a baby is at once intense, familiar, and sad. Long before the development of language, the genes had presumably designed the brain to offer ample rewards to ensure attentiveness to the call of infants. It is possible that a chill is an accidental sensation evoked when music happens to approach the sounds we are programmed to react to as caregivers. However, it is also conceivable that a chill can be explained by the way evolution tends to utilize structures already present for novel purposes, as exemplified by the way legs evolved from the fins of fish. The need for positive sensations to encourage the processing and production of sounds, which I suggest appeared as a consequence of the introduction of language, may have triggered evolution to recruit the emotional pathways associated with parents' attention to the cries of their babies.

Sexual Selection

An artist may feel that reducing aesthetics to an innate trait does not do either music or art justice. It is important to stress that the biological approach reflects only one of several possible perspectives relevant to the understanding of art. Moreover, in present society art has gained a "life of its own," partly independent of our innate preferences for particular qualities. The suggested elements, and concomitant rewards, promote a preoccupation with certain types of sounds and visual stimuli. Obviously, the particular taste of an individual is governed by personal and cultural traits. Thus, the observation that the same music or painting may produce pleasure in one person and discomfort in another does not contradict the suggested aesthetic elements. It was pointed out already that art serves several cultural functions, such as communication with both humans and spirits. It is possible that these functions contributed to the evolution of our innate preoccupation with art. Communication involves obtaining attention. However, both attention and communication may be achieved without adding beauty. A traffic sign is perfectly designed for attracting attention, yet few would treasure it as a work of art. Paintings, on the contrary, are sometimes very subtle and quiet. Furthermore, much of the art produced, such as that of children or amateurs, is apparently made solely for the satisfaction of the creator, and not for communicating with others. The greatest works of art are probably produced when aesthetic elements are used to enhance the communicative content. The aesthetic rewards are then added to associative rewards, creating a particularly strong impression. It is also likely that sexual selection spurred the evolution of our aesthetic disposition; that is, mate choice may have depended to some extent on musical and visual artistic abilities. Most of the advanced acoustic signals in nature are courtship signals. It is easy to imagine that competence in singing, or in following a rhythm, has improved the odds of success in a human courtship situation. The theory would help explain why love is the most

popular theme for songs. Skill in decorating the body may have served a similar purpose.

Although cultural functions, particularly in terms of sexual display, probably contributed to the evolution of aesthetic appreciation, it seems unlikely that they represent the primary mover. I believe the aesthetic elements of the type described in this entry preceded possible social benefits. Sexual selection tends to expand particular features, among the more famous are the peacock's feathers, but generally the feature to be expanded was present before sexual selection started using it. In the absence of the aesthetic elements, the other functions of art would probably not have emerged.

For the Service of Life Quality

The life of dogs depends on a keen sense of smell. Dogs are unlikely to insist on going to a concert, or to an art exhibition, but they certainly would appreciate a "gallery" where they can sniff interesting odors. Compared to dogs, we are expected to derive more pleasure from auditory and visual signals, and less from olfactory signals, simply because the auditory and visual signals are more important for human survival. Present music and art are designed to hit pleasure circuitries in the brain with maximum power. The artist accentuates the elements capable of stimulating brain rewards. That is, they offer exaggerated stimuli akin to the way a nesting bird will prefer a plastic egg if it is bigger than the real egg. The role of art in present society is far from being adaptive in a biological sense. Then again, there is no reason why it should be. It seems more rational to define the purpose of life as improving life quality, rather than maximizing procreation. The term *Darwinian Happiness* offers an expansion of this way of looking at quality of life. The various reward mechanisms activated by aesthetics offer an excellent strategy for happiness. Artists, who are capable of finding novel ways of hitting the relevant rewards, should be valued. Au3

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