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The Human Passion for Music

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Definition: Music is a universal feature of human societies, which suggests that an evolutionary perspective should help us understand our appreciation. The reward (pleasure) system of the brain offers a suitable framework. The question is why we evolved rewards for listening to and producing sounds with particular qualities. The primary evolutionary advantage is probably related to the importance of language; features of sound, such as purity, harmony, complexity, and rhythmicity, are useful for facilitating oral communication. One would expect evolution to associate rewards with these qualities in order to stimulate the development of brain regions involved in interpreting and producing relevant sounds. There are additional adaptive aspects of music, such as relaxation, social coherence, and sexual selection. Music can be regarded as a superstimulus that accentuates and exploits rewards associated with hearing. As such, music is not necessarily adaptive in a biological sense, but serves the purpose of improving quality of life.

Keywords: music; hearing; behavior biology; evolution; brain rewards; pleasure; language; play behavior

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1. Introduction

Most people can easily distinguish music from other sounds; in fact, an interest in music appears to be a universal human feature [1,2]. Tribal cultures do not have advanced instruments but create music in the form of song and rhythm; the first instrument found, in the form of a flute, dates back some 40,000 years [3]. Further evidence, as to an innate component of musical appreciation, are, for one, that the capacity appears to arise spontaneously in infants [4]; and two, that music has a powerful effect on the human psyche [5,6].

To the extent that the phenomenon is innate, an evolutionary perspective should help explain why we care about music, and, possibly, suggest what features of music tingle our brain in a way that cause the engagement. However, music is also a social phenomenon that serves various functions in a community [7]. A biological explanation can only account for the inborn aspects; cultural traditions may be more important when examining the role of music in a particular society. For example, in several African cultures, drumming is an important component of rites of passage.

In order to understand our fascination with music, it is appropriate to consider the way human brains use rewards and punishment to guide behavior [8]. Aesthetic experiences are about how particular types of sensory input cause our brains to offer rewards in the form of enjoyment. Humans have a variety of senses, including vision, hearing, touch, and smell. Stimulation of any of our senses can activate rewards and punishment, in the form of pleasure and pain, where pain is used for any type of negative experience. Aesthetic experiences are primarily related to hearing and seeing. As to music, the question is why certain types of auditory stimuli are processed in a way that causes them to activate pleasure and, one may add, why this form of pleasure is so easily amenable to and enhanced by human creativity.

The brain receives a multitude of auditory input. Much of it is neutral, that is, it activates neither pleasure nor pain. Some of it is hideous, most people dislike the

sound of chalk on a blackboard, but a considerable variety of sounds has the potential of inducing pleasure.

Sounds are simply variations in air pressure registered by the eardrum and translated to neuronal signals in the cochlea. Humans do not have the most sensitive ears, in terms of signal strength and frequencies registered, but we may have the most advanced neurological processing of sounds. Signals from the cochlea are sent by the auditory nerve to the thalamus and then passed on to the auditory cortex where the main part of the processing and interpretation presumably occurs. Translating minor variations in air pressure into language and recognizing not only where the sounds come from but who is speaking, are extraordinary tasks. It is to be expected that the brain needs to develop this capacity as we grow up.

All mammals have a capacity to hear, but only humans have developed this faculty into oral language. Although music can play a role in communication, the spoken word seems to be superior for that purpose. Consequently, listening to or creating music seems unlikely to be directly important for survival; it is a paradox that people, nevertheless, devote so much time and energy to doing just that. The obvious explanation is that it makes them feel good. The reward system is meant to stimulate adaptive behavior, but if the spoken word is superior for the highly adaptive purpose of communication, why care about music? I shall suggest an answer to this question. The topic is partly covered in a previous book [9].

As pointed out above, music has a communicative aspect, which means it is important to distinguish between the pure enjoyment of the sounds and possible rewards connected with the associations fostered. Love songs may, for example, stimulate some of the positive feelings involved in love. The present focus is on features of music that are not communicative. These features appear to be reasonably universally recognized and appreciated across human cultures [10].

2. Feelings Are Meant to Motivate Behavior

The positive experience when listening to music implies that the brain activates rewards when we hear sounds with the right quality. In order to understand why we have this propensity, it is important to first outline why the brain has the capacity to give us pleasure and pain. The short answer is that it motivates us to make appropriate behavioral decisions. The model of the brain I shall use, and the accompanying terminology, are briefly explained below. For a more detailed account, see [11].

Feelings include any experience with a positive or negative connotation. They can be divided into sensations, which reflect pleasant or unpleasant experiences due to signals from our senses, and emotions, which include other forms of feelings, but are typically associated with interpersonal relations. Feelings are of two types, either good or bad (rewards or punishment), simply because they are meant to direct us respectively toward something that benefits the genes (e.g., food and mates) or away from anything that is detrimental (e.g., predators and injury).

The concept of modules, or functions, is a convenient simplification when describing the inventory of the human brain. Modules consist of widespread nerve circuits but are often associated with certain anatomical regions. Various modules can use overlapping nerve circuitry.

Whether positive or negative, the experiences that we refer to as feelings are generally based on two overarching modules in the brain: The mood module is responsible for the positive or negative element of feelings, that is, the pleasure or pain, while type modules stand for the 'characteristics' of a feeling. For example, the taste of sugar and listening to music both activate the reward part of the mood module [12,13], but they are considered very different conscious experiences. The difference is due to the concomitant input from type modules, here in the form of the brain modules responsible for processing, respectively, taste and sounds. Similarly, a physical injury activates the pain part of the mood module, but so does being rejected by a friend [14].

The mood module can be divided into three submodules: two that create positive feelings (typically referred to as seeking and liking), and one that cause all forms of pain [15,16]. The former two are here combined and referred to as the reward module. The mood module establishes a form of 'common currency' that allows the individual to balance advantages and disadvantages [17]. For example, the pleasure of taking another piece of cake is weighed against the negative feelings of doing something unhealthy.

The point of feelings is to guide behavior. If an experience elicits a strong reward, whether it is eating a cake or listening to an opera, the person tries to obtain more of the same experience. Feelings are typically initiated by nonconscious processes in the brain, which means the individual can be compelled to follow their call without necessarily understanding why. Conscious deliberation, in the form of our level of free will, can to some extent impact on or overrule the nonconscious brain [18], but it is difficult to turn feelings on or off.

What triggers a particular feeling is to a large extent based on previous experiences. It means that a particular event can be either positive or negative depending on both personal factors and minute details in how the situation is perceived. Some people enjoy the thrill of a danger, such as climbing a mountain, while others consider the same task to be unpleasant. If the person who enjoys climbing slips and falls, the activity is likely to turn abruptly from positive to negative.

The positive and negative aspects of a feeling are not necessarily obvious. We can be swayed by 'drops' of satisfaction without being consciously aware that there is any pleasure involved [19]. Moreover, we may follow the call of the reward module even when we dislike where it takes us, as exemplified by drug addicts and other forms of compulsory behavior.

The evolution of the mood module, and thus feelings, probably started more than 300 million years ago with the appearance of the first amniotes [20]. As a strategy for directing behavior, feelings are not necessarily adaptive in present, industrialized society. The human brain was shaped at a time when the conditions of living where considerably different; abuse of narcotics, or binging on unhealthy food, are common examples of dubious behavior due to opportunities in the present environment. If the same opportunities had been easily available in our distant past, evolution would presumably have installed a strategy to avoid this sort of behavior.

The point of the above paragraph can be generalized by stating that reward-driven behavior not always serve an adaptive purpose. For example, people enjoy sex in the presence of contraceptives even though the activity does not propagate the genes. Likewise, creating sounds with aesthetic value and spending time listening to music do not necessarily imply any evolutionary advantage, but may reflect the activation of rewards in the brain. Below, I shall discuss various factors that help explain why music elicits rewards.

3. The Aesthetic Elements of Music

3.1. The Language Connection

In order to understand music, it is important to describe why the brain tends to process certain forms of auditory stimuli in a way that causes the activation of the reward module. The particular quality of sounds required are referred to as aesthetic elements. The list of elements should be restricted to those that are reasonably universal, and thus likely to reflect innate tendencies, rather than those that apply only to certain individuals or certain cultures. The activation of the reward module suggests that catering to these aspects of sounds offered an adaptive advantage at some point in our evolutionary past.

In animals, the capacity to hear serve several functions, the two most common are: one, to alert the individual in case of danger; and two, to communicate with members of the same species. Evolution expanded the latter function to an extreme degree in humans. For us, language has considerable adaptive value, which suggests that language played a pivotal role in the evolution of our capacity to enjoy music. Several authors, starting with

Darwin in his book *The Descent of Man* [21], have proposed a connection between music and language; for a recent review, see [22].

Homo sapiens is not the only species that communicates by sounds, but for typical mammals, smell in the form of pheromones is more important. Olfactory signals are not suitable for animals that spend most of their time in water or in the air. These animals, including cetaceans (whales), bats, and birds, have evolved superior forms of oral communication. Humans live on the ground, so we do not fit directly into this picture, but we did evolve a particularly advanced brain that allowed for a fine-tuning of information exchange far beyond that of any other animals. It is difficult to turn smell into complex information, but auditory signals can. What is needed is an expanded capacity to interpret and create sounds of the right quality.

Humans arguably have the best brain when it comes to interpreting auditory signals and the most advanced vocal apparatus. The production of speech typically involves the coordination of more than two hundred muscle movements every second [23]. These features presumably evolved concomitantly with our capacity for oral communication. However, this capacity also required an additional change in the brain; the extreme complexity of language means it cannot be entirely preprogrammed, the individual must gradually develop the competence after birth. Evolution typically uses what we refer to as play behavior to make sure the individual takes part in the necessary training.

Play behavior is meant to help the individual develop skills required later in life; for example, in the form of improving the nerve circuitry required for muscle coordination. As play is an important activity for the genes, it is coupled with rewards in order to ensure participation. Children enjoy their play. Both the capacity to interpret sounds and to use the voice require extensive practice. The brain presumably offers concomitant rewards for this practice, whether in the form of babbling or listening. In short, exercise is required in order to develop our innate template for language [24], and music appears to be a suitable form of sound for this endeavor. It has, for example, been shown that children who receive musical training improve their reading skills [25] and are better at remembering words [26].

There are some caveats to this idea. If our joy of music is due to the need to exercise our auditory and vocal capacity, why music? One might argue that any sound would do, and that if there is a preference, spoken words would be the obvious choice. Moreover, play behavior is primarily associated with children, so the interest in music should decline along with puberty.

As to the latter point, even when the main circuitry required for language has been established, the mind still needs to be preoccupied with sounds. For one, the complexity of oral language suggests that adults as well are required to exercise their interpreting and sound-producing capacities; and two, humans use the senses, hearing in particular, for exploratory behavior. Exploratory behavior is also associated with brain rewards, and it implies taking an interest in sounds. Obtaining information from the environment is even more important for adults, as they are responsible for safety and for finding food.

Considering the awesome emotional power of music, can it really be explained solely by play or exploratory behavior? I believe the rewards associated with play and exploration are likely to have been the starting point for our present capacity to enjoy music, but that they do not offer a complete answer. I shall first discuss features, here referred to as aesthetic elements, of music that makes it suitable in connection with the practice of oral communication. These features suggest why we have a fascination for music rather than focusing solely on spoken words. Subsequently, I shall consider other factors that are not directly connected with communication but are likely to help explain why the rewards are so powerful.

3.2. Sequential Information

Chimpanzees produce perhaps thirty or more calls with distinct meaning [27]. A key difference between their and our oral communication is that, for them, each sound has a particular connotation. Additional information can be extracted from loudness and

repetition, but they do not form syntax. For humans, a single sound is typically without meaning, we need to combine sounds sequentially to produce content—language is based on words and sentences. Sequential information, or temporal patterning, is also important in music. In order to be appreciated, a melody needs a variety of tones tied together by principles such as harmony and scale.

3.3. Complexity, Coherence, and Fluency

Bird song may be pleasing but it lacks certain qualities compared to human song or music. It appears to be stereotypic, predictive, and repetitive; we cherish more complexity [28]. As pointed out above, language requires complexity in order to convey detailed content. An alarm clock, or any sound based on one or a few frequencies, is not interesting and thus not equally rewarding. A measure of intricacy is needed for human exploration, the sounds need to stimulate our curiosity. If the sound becomes too complex, like scrambled noise, it does not offer any feature that allows for interpretation. We presumably prefer some level of coherence in the form of principles that connect the various facets of the sounds and thus offer a substrate for analysis. The idea of coherence is related to the concept of fluency in visual aesthetics [29]. A high fluency implies that the visual or auditory object is easy to process; in the case of sounds, the listener automatically senses that the components are tied together and form an entity.

A sudden surprise in music may be felt as an unpleasant startle, but for a person in a safe setting and not prone to fear, it is more likely to stimulate curiosity. We like to investigate novel forms of stimuli but prefer a certain level of familiarity. Music typically offers a series of interesting surprises set against a background of expectation.

3.4. Purity and Harmony

Purity of notes, that is, using a particular pitch or frequency as opposed to scrambled noise, is a key feature of music. The same is consonance and harmony, which imply that the different frequencies stand in a particular relationship to each other. A preference for purity and harmony appears to be innate [4]. One reason why these qualities are favored, which means they offer drops of rewards when heard or produced, may be that they enhance oral communication.

The ability to produce pure sounds is found in animals where auditory signals are the main form of communication, a list that includes most birds and whales [30]. Pure sounds presumably are less ambiguous and travel further. Consonance reduces ambiguity. It is easier to interpret a message with distinct frequencies compared to more random sounds.

Language consists of a mixture of relatively pure (vowels) and dissonant (the alphabetic consonants) sounds. In certain languages, the meaning of a particular syllable depends on the pitch; these are referred to as tone languages and include Chinese. Chinese speakers seem to be better at hearing variations in pitch compared to those who learn non-tonal languages [31]. Perhaps the first human languages depended to a larger extent on both pitch and purity of sounds; that is, they were more like what we refer to as song [32,33].

Did we sing before we could talk? The idea makes sense, not the least because the oral communication of birds and whales is referred to as song. Moreover, a plausible explanation for why we stopped singing and started talking lies in the increased need for complexity for the sake of communicative detail. Complexity was achieved by including more dissonant sounds (the consonants). In short, communication moved from song to the spoken word because of our enhanced intellect and the concomitant need to increase the capacity to accurate communication. Apparently, the reward system still favors purity and its cousin harmony; in other words, the song stage may have left relics in the form of a (partly) 'irrational' like for music. It is interesting to note that children first manage the vowels, but need more time to master the consonants [34]. Some of our ape relatives, the gibbons and siamangs, have evolved the capacity to sing [35]. These apes live in the canopy where, as in the case of birds, olfactory communication is less suitable.

3.5. Rhythm

Rhythm is a characteristic feature of most music. Rhythm instruments are easier to make (a stick and something to hit the stick against suffice); thus, in tribal cultures, they are more common than wind or string instruments. Here, the core function of rhythm is obvious, not the least because the music is often combined with dancing.

Even modern music tends to require rhythm in order to be appreciated. The beat may serve several functions: It offers a way to sequentially organize the sound. It is also likely to be a comforting feature, because dangerous sounds do not tend to be rhythmic, and perhaps because it resembles the pulse of the mother's heart as registered in the uterus [36]. Finally, rhythm is a feature associated with several aspects of behavior in various species [37].

3.6. Emotions and the Human Touch

Music can include a distinct communicative element, for instance, in the form of a love song, but even purely instrumental music can reflect mood or other qualities of the person(s) producing it. Our social nature implies that we are curious about fellow human beings, which means we are rewarded for deciphering a human touch. When a person creates sounds, we tend to search for clues about his or her emotional life. A voice offers this sort of information, whether it is speaking or singing, and so does an instrument in the hands of a musician. In fact, people tend to agree on what emotions a given sequence of music reflects [38].

The emotional content can be directly appealing, such as music designed for the listener to feel joy and elation. This effect is achieved if the melody appears to be due to similar emotions in the performer [39]. In this context, it is relevant to point out that even sadness can have a positive connotation, which here implies activation of the reward module. For example, grief can be regarded as either a negative or a positive experience; the point is not only apparent in how people describe what they go through, but can be seen when analyzing the parts of the brain active while reporting grief [40]. The positive experience of sad music may partly reflect that we are rewarded for empathy and compassion [41].

The sense of connecting with the performer implies that music can also serve as a 'companion'—somewhat like a pet. That is, it reduces loneliness and offers rewards related to socializing [42]. The point may help explain why music is so popular among the young of companion-starved Western societies.

3.7. Relaxation

Music can have a relaxing effect not only on humans, but on animals as well [43]. Both rhythm and the fact that music tends to be smooth and continuous may help explain this observation.

A composer may include strong and abrupt sounds for captivating an audience, but this music is typically not used by the farmer who wants to calm his cows, or by the supermarket where the point is to create a relaxed and positive atmosphere. In a natural environment, sudden unexpected sounds typically imply danger; smooth and continuous sounds, whether in the form of music or the flow of a river, suggest peaceful conditions. Sounds that are deemed safe relax the brain. Lullabies are, for example, meant to calm the infant. They are perhaps the most universally recognized form of music cross-culturally, and are typically slow, soft, repetitive, and familiar for the child [2].

3.8. The Chills

The aesthetic elements suggested above may explain an appreciation for music, but the emotional response can be more overwhelming than what one would expect based on the anticipated strength of accompanying rewards. The intense pleasurable experience described as the chills is a classic example. Chills (or thrills) are a particularly strong emotional response felt as a shiver down the spine or a gooseflesh type of skin sensation [44].

One would expect evolution to restrict behavior to what is adaptive. A person who is preoccupied with music has less capacity to cater to other tasks or to avoid dangers. If you are totally mesmerized by a song, you may fail to detect a predator. That is, the rewards associated with music should not divert our attention to an extent that is nonadaptive. The chills appear to be excessive distraction.

The qualities of music that tend to produce chills point toward an explanation [44,45]. Chills are induced more often by sad than by happy music, by familiar music rather than novel tunes. Intense passages, such as crescendos, are particularly likely to induce chills. Furthermore, they are more commonly experienced by women than by men. It may be that these factors cause the sound to hook directly into one facet of the brain's emotional circuits; that is, they mimic the call of an infant crying for the mother. A baby's call for help is expected to produce a powerful reaction in parents and particularly so in mothers. The cries have properties related to chill-producing sounds: they are intense, familiar, and sad. Long before humans evolved the capacity for language, the genes had presumably designed the brain to offer rewards to ensure that parents would attend to their children. The chills may reflect an activation of this reward system.

It is also possible that the chills signify the way evolution tends to utilize structures already present for novel purposes, as exemplified by the way wings evolved from the forelimbs of reptiles. As oral communication became more important and complex, evolution needed to install potent encouragement, in the form of rewards, to make sure we would invest in learning to master this aspect of life. One way of ensuring interest would be to recruit the emotional rewards associated with parents' attention to their babies.

4. Sexual and Social Selection

There are additional factors that may have amplified the rewards of music. For example, it has been suggested that mate choice depended on musical aptitude, which means that sexual selection contributed to the evolution of music appreciation [22]. In animals, a large share of the vocalizations observed are courtship calls. The complexity of the calls are, at least in some species, likely a consequence of sexual selection; that is, the partner preferred those with the more advanced ability to vocalize. The idea of similar sexual selection in humans is congruent with the observation that love seems to be the most popular topic for songs.

Although sexual selection may very well have expanded our propensity and delight in music, elements such as those discussed above most likely came first. Sexual selection tends to accentuate certain features, but not to generate features from scratch.

Selection for social bonding or social cohesion is another possible factor [46]. There is no doubt that music can serve a role in society: it is commonly involved in both religious or secular social gatherings. Music and song are collective experiences, whether around the campfire or in a concert hall. The study of the sociocultural context of music has been referred to as ethnomusicology [47]. Again, the social factor is likely to have enhanced our capacity and pleasure in music, but is, in my mind, less likely to be the factor initiating the evolution of our appreciation.

5. Conclusions—For the Service of Life Quality

Dogs depend on a keen sense of smell. They are unlikely to delight in a concert, or an art exhibition, but I am sure they appreciate a 'gallery' with 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. Music is designed to hit pleasure circuits in the brain with maximum power.

The rewards elicited by individual aesthetic elements may be in the form of 'drops' too small to be recognized as pleasure. The appreciation presumably depends on the combination of several aesthetic elements that have limited relevance if presented in isolation. Another way of describing this is to say that music is designed to take advantage

of the reward potential of various auditory stimuli by combining them to yield a synergistic effect. The potent effect of music is reflected in the observation that it is used as a therapeutic tool for conditions ranging from stress and anxiety to dementia [6,48].

Factors such as social and sexual selection likely enhanced the evolution of human delight in music. Cultural conditions can either promote or subdue the actual production and consumption of music in a society, for example, in the form of economic incentives, status, censorship, and availability. In Western societies, the culture tends to promote a preoccupation with music.

The reward model of music is supported by the observation that music can take on an addictive character [49]. For some people, listening to music is reminiscent of the maladaptive behavior associated with addictive substances; for example, they knowingly insist on playing music so loud that it results in a loss of hearing, or so often that it prevents the execution of more important tasks.

Stimuli that release agreeable sensations tend to initiate excessive consumption if they are easily accessible; in present societies, music is readily available. As an addictive substance, however, music is about as good as they get. It certainly is less hazardous than drugs and unhealthy food.

Although some of the aesthetic elements suggested above may be relevant for animals, such as the calming effect [50], humans are likely to be the only species that really appreciate music. Birds sing and may very well be rewarded both for practicing their own vocal capacity and for learning to interpret what they hear; yet their oral communication appears to be largely based on preprogrammed systems [51].

The role of music in present society is not necessarily adaptive in a biological sense, but there is no reason why it should be. It seems more sensible to define the purpose of life as improving life quality [8], rather than maximizing procreation, and music serves this purpose well.

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