The Aesthetics of Information: A Bit of Beauty

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ABSTRACT
On the basis of the cyclical time model of consciousness, the aesthetics of arts and music is discussed in terms of the smallest unit of information, the bit. Previously, the chronological advancement of music was discussed in terms of an increase in randomness, which then led to a higher order. The musical beauty of a bit is considered in light of randomness and order being interconnected through a cyclical looping process, as seen in consciousness. On the other hand, the progress of the arts can be studied in terms of the interplay between physical and the mental aspects. It is argued that the artistry of a single bit may be associated with an attachment between the reality of the bit and the semantic meaning, or the conscious awareness of choice. The relevance of the proposed model of beauty in music and the arts to Heidegger's argument on existence and Wittgenstein's analysis of language is also discussed.

Key Words: Information, Beauty, Cyclical time, Language, Music, Arts

DOI Number: 10.14704/nq.2018.16.3.1116

Introduction
There are a number of significant questions in the field of aesthetics, the philosophical investigation into the nature of beauty (Dickie, 1997; Graham, 1997), raising intense debate. A central debate concerns how we should understand works of art and their appreciation. One school of thought argues that beauty ought to be analyzed using rationality, treating works of art like the natural phenomena of the sciences. For instance, Terrasson stated (Terrasson, 1715) that

The way to think about a literary problem is that pointed out by Descartes for problems of physical science.

For example, one important aspect of aesthetics comes from music, and there have been numerous approaches to investigating the scientific basis of musical order and beauty, particularly from mathematics and computer science (Garland et al., 1995; Wright, 2009; Loy, 2011).

However, there is also a school of thought opposed to the rationalist approach to beauty. For instance, the philosopher David Hume noted (Hume, 1757) that

Beauty is no quality in things themselves: It exists merely in the mind which contemplates them; and each mind perceives a different beauty.

Understanding the arts or music, i.e., as opposed to galaxies, electrons, etc., in terms of science appears to be difficult because the former seem to involve not only logical or computational processes but also human emotions. A similar predicament has been identified in the study of consciousness (Dahaene et al., 2001; Koch, 2004). Many have suspected (Searle, 1980; Penrose, 1994) that, as in the case of attempting to understand the human emotions involved in music or the arts, consciousness may be difficult to analyze in terms of logical reasoning. Indeed, it has been argued that consciousness has a non-computable element (Song, 2007). This then leads us to wonder if it would even be possible to analyze or define beauty in the arts or music in terms of information processing. This article, on the basis of an investigation of...
consciousness, will attempt to address artistic and musical beauty in terms of the smallest unit of information, i.e., a single bit.

![Diagram](https://example.com/diagram.png)

**Figure 1.** The irreversible process of the classical reference frame corresponds to the initial time-forward part of the loop, and the nondeterministic process of the quantum reference frame is identified with the other part of the looping process, with time going backward. This cyclical time model of consciousness has been applied to the vacuum as well as classical reality experiences.

**Computational Model**

In order to describe the aesthetics of a bit in a way that is analogous to consciousness, let us first review the computational model of self-referencing consciousness. In (Song, 2017b), consciousness was discussed in terms of a cyclical looping model. The process of consciousness may be outlined with the cyclical time model in much the same way as the looping process involved in the liar's paradox, where the initial time-forward part is "The following sentence is true" and the loop is closed with time-backward statement “The previous sentence was false.” In particular, the physical version of the self-reference looping process was applied to the observation of a vacuum (Song, 2017b) and physical reality (Song, 2017c) as follows:

1. The classical reference frame performs an irreversible computation
2. The quantum reference frame performs a nondeterministic computation

The first part of the cyclical loop corresponds to the process of the observer's classical choice being made in a time-forward manner, while the second part of the loop is the observer's mental reference frame evolving with time moving backward, i.e., the process of mental awareness of the classical choice (Figure 1). This cyclical looping version of consciousness is equivalent to the single-sentence version of self-observation where the observing party and the object being observed are identical.

In (Song, 2017c), the cyclical looping process of consciousness shown in Fig. 1 was applied to the experience of reality. In particular, it was argued that the classical choice of the observer corresponds to reality and that this experience is inseparable from conscious awareness of the classical experience through cyclical time.

**Musical Beauty**

The proposed model in Figure 1 bears a resemblance to Heidegger's analysis of the nature of existence, using the notion of *dasein*, or being-in-the-world (Heidegger, 1962). Heidegger has argued that existence is embedded in time, in past, present, and future. Indeed, the proposed model also indicates that cyclical time plays the role of interconnecting reality with consciousness. It is interesting to note that music has a number of components that are intimately related to time. Indeed, we wish to argue that the analysis of existence and cyclical time may provide the building blocks of musical beauty.

![Diagram](https://example.com/diagram2.png)

**Figure 2.** (i) The process of irreversible computation of a bit generates randomness in the sense that where the output came from has been erased (Landauer, 1961). (ii) The process of nondeterministic computation is a time-reversal process of (i), which may be considered as establishing an order.

In (Song, 2017a), the aesthetics of music was discussed in terms of chronological order. In the early days, music imposed a relatively well-defined theme. For instance, one of the most renowned symphonies of all time, Beethoven's fifth symphony, from the early 19th century, features a well-known melody that repeats itself throughout the movement. However, music has tended to progress toward themes that are less obvious. For example, the music of Rachmaninoff is also widely appreciated yet in general the themes are not as obvious as those of Beethoven are. Although this reduction in obviousness is accepted, the
musical beauty of later works cannot be said to have diminished. In fact, it may be argued that a higher order is accomplished with a less apparent melody, or increased randomness. This reduced theme or melody is even more minimized in a number of 20th-century works, such as those of Bartók or Schönberg’s atonal approach. That is, a higher order of musical beauty is achieved through increased randomness.

Let us consider the cyclical looping process with musical degrees of freedom associated with a bit. In the first part of the loop, an irreversible computation is performed, i.e., the input 0 or 1 is set to 0. This generates randomness since it erases where the output 0 came from (Figure 2 [i]). The closing part is the time-reversal process of irreversible computation, namely, nondeterministic computation, which follows the acceptable path to where 0 came from. Since this is the time-reversal process of randomness, it establishes an order, i.e., the musical degrees of freedom establishing the order of one bit (Figure 2 [ii]). Thus, the role of cyclical time is to interconnect randomness and order and, based on the previous discussion of the aesthetics of music in chronological order, this inseparability ought to be the essential ingredient of musical beauty (Figure 3).

**Artistic Beauty**

The cyclical time model in Figure 1 has shown the role of time in interconnecting reality and consciousness. It is notable that Wittgenstein also discussed (Wittgenstein, 1922) the role of language in a way that resembles that of time, i.e., language attaches semantic meaning to reality. In particular, he used a “picture” as an example to explain the special role of language. Artistic paintings may be considered one type of language in the sense that they may be represented through binary bits. Motivated by the similar roles played by artistic paintings and language, we wish to outline the smallest unit of artistry.

In (Song, 2014), the relationship between the physical and the mental aspects was discussed in terms of advancement in art history. For instance, in Leonardo da Vinci’s *Mona Lisa*, from the 16th century, the description of the woman is well provided and the actual appearance of the model can be assumed without much difficulty. That is, there is less room for the involvement of imagination. However, this dominance of the physical over the mental in artworks begins to diminish. In Monet’s Impressionist painting *Woman with a Parasol* from the 19th century, it is rather difficult to provide an actual detailed description of the person, i.e., more imagination may be involved.

![Figure 3. The Musical Beauty of a Bit: The cyclical time process interconnects the process of randomization, of one bit’s musical degree of freedom in time moving forward, and the establishment of order, with time going backward. This cyclical time process, which produces the inseparability of the two parts of the loop, may be associated with the aesthetics of music in terms of a single bit](image)

This trend of an increase in the mental over the physical is magnified in Cubism, such as the works of Picasso, as well as in the abstract arts, such as Kandinsky’s paintings. Certainly, there is much more to the progress of art than the simple advance in emphasis of the mental over the physical, as described here. However, it is understandable that the interaction between the mental and the physical is associated with artistic beauty. In (Heidegger, 1977), Heidegger also discussed the nature of artistry, using the example of van Gogh’s *A Pair of Shoes*.

![Figure 4. The Artistic Beauty of a Bit: Artistic paintings, or language, connect one physical bit with the conscious awareness of the bit. That is, the artistic beauty of a bit may be associated with its inseparability from its mental semantics](image)
Let us now consider the artistic beauty of a bit as follows: In the first part of the looping, the physical part of a bit is experienced, while the conscious (i.e., the mental) awareness of the physical bit corresponds to the second part of the loop. As discussed earlier, Wittgenstein noted the role of language in connecting semantic meaning to physical reality and the concept of a picture was used in explaining the role of language. We wish to take Wittgenstein's example and argue that painting, as language, in fact plays the role of attaching semantic meaning to the physical. In fact, that is what the looping does, i.e., artistry is associated with the inseparability of the physical reality of a bit and its semantic interpretation (Figure 4).

Remarks
One of the issues involving the foundation of beauty has been whether it is subjective or objective. People advocating the subjective view argue that every person feels differently about the perception of beauty. Nonetheless, there are certain artworks that many people consider to be beautiful or artistic, while there are others that most people do not consider artistically valuable. This leads us to wonder whether beauty has some objective element to it.

Unlike aesthetics, it has been generally assumed that scientific study is about revealing an objective reality (Einstein et al., 1935), i.e., something that does not vary depending on who is practicing it. This objectivity assumption has remained over a long period of time and has influenced people's thinking in a number of ways. However, with the arrival of quantum theory, the premise of objectivity was shaken, and there has been continuous debate about its precise meaning and implications at the fundamental level for almost a century (Peres, 1997).

With the confusion over subjectivity and objectivity in quantum theory, it is interesting to consider the foundations of aesthetics, in which the debate has lasted much longer, from a scientific perspective. In this paper, we have argued that the cyclical model of existence may be associated with both musical and artistic beauty. In the case of music, the cyclical process of a bit provides the interconnection between randomness and order, which is associated with musical degrees of freedom and the interconnection, would comprise the beauty of the music. In the case of art, as with language, the painting of a bit provides an interconnection between the physical bit and the semantic meaning of the bit, and the artistic beauty is provided through the inseparability of the two parts of the loop.

One particular significance of the proposed model may be that it attempts to outline the smallest unit of a seemingly abstract notion of beauty. Just as the study of objects such as atoms, electrons, and other elementary particles helped tremendously in our understanding of nature as a whole (Griffiths, 1987), the identification of the building blocks of beauty may help us to understand the human emotions in general.

References