The Uses of Beauty

by Semir Zeki
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INTRODUCTION

What are the uses of beauty? Is it there merely to adorn and embellish and thus give us pleasure? Is sexual selection its ultimate aim, as Charles Darwin supposed in *The Descent of Man*, or does it have other uses besides? These are questions that have long been debated. Neurobiology in general, and neuroesthetics in particular, do not address these general questions. Instead, they limit themselves to asking a much more manageable scientific question: “What are the neural mechanisms that are engaged when humans experience beauty?” Although this question constitutes an incursion into private, subjective states, it is not that different from asking, for example: “What are the neural mechanisms that are engaged when humans experience colour?” Colour, too, is a subjective experience; Arthur Schopenhauer realised this long ago.

In Schopenhauer’s *On Vision and Colours: An Essay*, he wrote: “A more precise knowledge and a firmer conviction of the wholly subjective nature of colour contributes to a more profound comprehension of the Kantian doctrine of the likewise, subjective, intellectual forms of all knowledge, and so it affords a very useful introductory course of philosophy”¹ (my emphasis). The study of the neural mechanisms of aesthetic experiences does not constitute, therefore, a radical departure from the scientific endeavour. Rather, it is a continuation of a long line of work that enquires into the neural mechanisms underlying different subjective mental states; from sensory ones such as colour vision, to more abstract ones such as aesthetic experiences. Experiments have demonstrated that brain mechanisms are active during aesthetic experiences. Moreover, the cerebral activity is quantitatively proportional to the intensity of the declared subjective experience. This is to say, the more intense the experience, the more profound the activity.

Although neuroesthetics does not address the question of what beauty is, a study of the neural mechanisms engaged during aesthetic experiences raises important questions about the role and uses of beauty, which are worth examining briefly.

A SUMMARY OF THE RELEVANT RESULTS

Different experiences of beauty correspond to activity in different parts of the brain. Musical and visual beauty, for example, lead to activity in visual and auditory cortex, respectively, *inter alia*. Activity in the same cortical area, the medial orbitofrontal cortex (mOFC) of the emotional brain, also correlates with the experience of beauty derived from visual or musical sources,² as well as from highly cognitive sources such as mathematics.³ Moreover, the intensity of the activity in the mOFC is parametrically related to the declared intensity of the aesthetic experience: higher for those experiences declared by subjects to be very beautiful than for those expressed as less beautiful. In neurological terms, there is, therefore, an abstract quality to the experience of beauty, not tied to the source of beauty itself.

This is a remarkable result with implications worth considering.

Mathematical beauty stands in contrast to sensory beauty; it represents the most extreme example of beauty that is dependent on culture and learning. Only those highly knowledgeable in mathematics can experience and rate the beauty of its formulations. By contrast, any individual, regardless of ethnic or cultural background, will experience a visual scene or a musical excerpt based on their own opinion of how beautiful it is. Hence, it comes as something of a surprise that the experience of beauty derived
from these two distant sources correlates with activity in the same part of the emotional brain. What can such an overlap mean?

**BIOLOGICAL AND ARTEFACTUAL BEAUTY**

From a neurobiological point of view, it is perhaps useful to divide beauty into two categories: biological and artefactual. Biological beauty is somewhat uniform across races and cultures. It is common knowledge that, in spite of the cross-race effect, an individual deemed to be extremely beautiful in one society or culture is likely to be deemed beautiful in another culture or ethnic group; and what is regarded as beautiful will follow certain biological rules. It is, for example, rare for someone to report that a highly asymmetrical face or body is beautiful; it is much more likely that, to be judged as beautiful, a face or body must conform to certain inherited concepts. Francis Bacon understood this implicitly and put it to effect in his work. He once said that his aim in painting was “to give a visual shock”. He achieved this feat by distorting faces and bodies and thus subverting the brain’s representation of them. By contrast, there is little distortion of objects in his paintings and evidence shows that, in terms of brain activity, faces and bodies are much more susceptible to the effects of distortion than objects (artefacts).

When first considered, the experience of mathematical beauty, derived from a highly intellectual source, would seem to be remote from an experience that can be described as biological. Yet, a closer inspection of it raises doubts. Although mathematical beauty is based on experience and learning, mathematicians belonging to different cultural and racial groupings can experience mathematical beauty, provided they know the language of mathematics. Hence it cannot be so culture-bound or, if it is, it must be restricted to a unique culture shared by all mathematicians, namely the culture of mathematics, and independent of their other cultural milieu and their ethnicity. So, what does the experience of mathematical beauty signify? For Immanuel Kant, it is based on the supposition that “Aesthetic judgments [are]...expressions of our feeling that something makes sense to us”. This, however, raises the question: to what does it make sense? A plausible answer is that it makes sense to the deductive, logical system of the brain and that the same logical deductive system operates in the brains of mathematicians belonging to otherwise different cultures. Hence, mathematical beauty perhaps tells us something about the functional structure and the logical systems of our brains. It belongs, in brief, to the category of biological beauty.

This is not as radical a suggestion as one might think. Though difficult to comprehend for many, Albert Einstein’s theory of relativity, published in 1915-1916, was widely accepted at first because of the extreme beauty of its mathematical formulations. Paul Dirac wrote: “What makes the theory of relativity so acceptable to physicists in spite of its going against the principle of simplicity is its great mathematical beauty. This is a quality which cannot be defined, any more than beauty in art can be defined, but which people who study mathematics usually have no difficulty
in appreciating. The theory of relativity introduced mathematical beauty to an unprecedented extent into the description of Nature. We now see that we have to change the principle of simplicity into a principle of mathematical beauty. The research worker, in his efforts to express the fundamental laws of Nature in mathematical form, should strive mainly for mathematical beauty. He should still take simplicity into consideration in a subordinate way to beauty. It often happens that the requirements of simplicity and of beauty are the same, but where they clash the latter must take precedence.9

One of the major functions of the brain is to acquire knowledge about the world. To do so, the brain must stabilize the world by processing the signals which it encounters. Colour vision provides a very good example. The colours of objects and surfaces in our world do not change, even in spite of wide-ranging fluctuations in the wavelength-energy composition of the light that is incident on, and reflected from, them. A green leaf will remain green when viewed at dawn or at dusk, or when viewed at noon on a cloudy or sunny day (although its shade of green will naturally change). Yet, if one were to measure the wavelength composition of the light reflected from that leaf under these different conditions, one would find huge variations. By an intricate mechanism, the brain is able to discount these continual changes and assign a constant colour to a surface,9,10 thus giving us knowledge through colour.

Equally, mathematical formulations, which have led to so many advances in our understanding of the structure of our universe, are a means of stabilizing the world in a similar way that the brain stabilises the green colour of the leaf. If the beauty of a mathematical formulation is a guide to its veracity, as Dirac and others have maintained, then beauty has a use that goes much beyond Darwin’s sexual selection. It leads us to a more profound understanding of both our brains and of our universe.
REFERENCES
