Aesthetic Evaluation of Art: A Formal Approach

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Abstract and Keywords

This chapter presents an analysis of the attributes (termed *qualia*) that are perceived in works of art, such as painting, architecture, and music, and how they determine how the work is evaluated by the viewer and the artist. A formal model is proposed to account for the role of the multiple attributes in the evaluation process, whereby their number, weight, quality, and their interactions are construed as compound causal factors. The formal analysis of concurrent attributes is meant to serve as a *conceptual* blueprint and guideline for viewing art and understanding the process of its evaluation. The model makes empirically testable predictions relevant (e.g. to minimal art) and provides a basis for an explanation of its aesthetic appeal and complexity. The chapter also addresses the problems inherent in the search for brain mechanisms.
involved in the encoding and response to the experienced concurrent qualia in artworks.

Keywords: qualities, qualia, art, architecture, theory of evaluation, attributes of art, mathematical model, classical modern, minimalism

24.1 Introduction

Every compound stimulus that impinges upon the organism can be perceived in multiple ways. For example, a visual scene will be unlikely to have an invariant impact on a population of viewers, as each will “perceive,” “sense,” “associate,” “respond to” the display in a different way, depending on the history of experience, on momentary state variables, and probably genetic determinants. Even the repetitive presentation of the same display to one observer will be likely to have different effects, each presentation being influenced by the effects of prior presentations (as we will discuss below, perceptual systems, attention mechanisms, and cognitive processes habituate or adapt to repeated input and, thus, change their response to the input). An important set of determinants of variation to visual (or auditory, tactile, olfactory, taste) input between viewers and within viewers themselves is the notion of multiple attributes of complex stimuli. For example, any photograph or painting can at any given time be viewed on the basis of many different parameters depending on the momentary state (e.g. mood, expectation) and history (education, cultural background, experience) of the viewer. This holds for the viewing of any complex stimulus, including any work of art. A work of art can be considered as a compound of attributes or qualities on the basis of which it will be perceived as well as evaluated. These attributes can be relatively simple variables such as color, size, and grain. They can be emotionally charged variables designated by terms such as “novelty,” “beauty,” “spiritual,” “sublime,” “monumental,” or formal aspects of a work that can be defined by basic compositional terms such as form, space, balance, and harmony. They can also be information with associative value based on representational and figurative content loaded with “meaning,” as in expressionistic and representational art. Then there are complex qualities related to experimentation, playfulness, innovation, and conceptual
art (see section 24.4 below). The number of possible attributes of a compound stimulus is endless and a list of the attributes of a particular work can be many or few, depending on the viewer’s state and experience. A sophisticated viewer will be able to perceive as well as verbalize more attributes than a novice.

The viewer’s evaluation of a work of art is related to the experienced attributes of the work. Here we can already ask whether or not these functional attributes must be consciously perceived to affect the evaluative process. Since we have no notion of an answer to this, we will simply assume that any experience of an object—be it “conscious,” with the viewer being aware of it, or “unconscious”—has a corresponding representation in the brain which can lead to an action (i.e. a response to the experience) and thereby influence the evaluative process.

We proceed on the basis of the postulate that the multiple attributes of a work determine the viewer’s evaluative response to the presentation. It follows that if one can define the functional attributes of a work and their relative importance and integrity, we should be able to predict how the work is evaluated and potentially have a measure of its worth for the particular viewer. Accordingly, we will here present an attempt to formalize the relationship between the multiple attributes of an image in determining the viewer’s overall evaluation of the work.

Our approach to modeling the aesthetic judgment can be seen in the context of earlier attempts at computational aesthetics as, for example, expressed by the mathematician G. D. Birkhoff’s formula or “aesthetic measure” which was based on the assumption that aesthetic objects derive their quality from their numerical or geometrical characteristics; that is, that the pleasure derived from an image equals the ratio between the order (0) and the complexity (C) in the object: \( M = \frac{O}{C} \) (Birkhoff 1933). Most of the many attempts at formalizing aesthetic experience dealt with the analysis of individual attributes of a work or subsets of such, as for example the debate on the role of the golden ratio (\( \varphi \)) as a source of architectural aesthetics, whereby two quantities are said to be
in the golden ratio if the ratio of the sum of the quantities to
the larger quantity is equal to the ratio of the larger quantity
to the smaller one:

\[ \frac{a+b}{a} = \frac{a}{b} = \varphi \]

with the following solution: \[ \varphi = \frac{1 + \sqrt{5}}{2} = 1.6180339887 \]

Baumgarten (1739) already declared the laws of beauty, like
those of nature, to be amenable to systematic, empirical
investigations via a new science, which he named *aesthetic*
(the judgment or estimation of taste or of the beautiful), the
object of which was to assess perception whereby particular
representations are combined into a whole; that is, to
translate the unity of perception into measurable variables.
Subsequent formal mathematical approaches (Lappin et al.
1995; Wenger and Townsend 2001) can be said to derive from
the Gestalt psychologists’ attempts to account for particular
aspects of our perception of motion, faces, texture, etc., on the
basis of our ability to generate and recognize whole forms
from simple elements, with the emphasis on *the whole being
greater than the sum of the parts.*

Unlike the many attempts to model particular attributes of a
work and their role in aesthetics, we will present a formal
theory of their individual and compound roles in the resultant
total evaluation (appreciation) of a display or work. We believe
that such a formal approach to dissecting the elements of
displays and objects can serve as a *conceptual guide* to our
active viewing and understanding of the complexities of
evaluation of works of art.

24.2 Qualia (Qs) and aesthetic evaluation

From here on we will arbitrarily focus on visual presentations
and designate their attributes as “qualia.” The term
"*qualia*" (singular “quale”) is a loose designation for a concept
that encompasses how we experience the world (e.g. Lewis
1929; Chalmers 1995; Horgan 1984). Synonyms for qualia
might include features, attributes, percepts, qualities,
sensation of, or subjective experience of an image. There is no
consensus in the use of this term, which has engaged many
philosophers in their attempts to account for issues of
phenomenology related to perception, subjective experience,
and the mind–brain relationship. We use the term “quale” to refer to a strictly subjective experience of the observer in response to a stimulus. A quale is a virtual property—solely an inner experience that has no physical reality in the sense of being a property of the stimulus, display or object itself in the physical world that is being viewed (e.g. Schrödinger 2001; Perkins 1983).

The major variables we postulate as determinants of the subjective evaluation \(E\) of an image or any work of art are its attributes or qualia \(Q\). Each quale has a value \(g\), which is a measure of its integrity or goodness, as well as a value weight \(w\), which is its relative importance for the particular work. The weight and importance of the quale determine its level of dominance or primacy over other qualia and also the nature of the interactions between the constituent qualia in their influence on the momentary subjective experience of the work.

How do these variables relate to each other in deciding the subjective evaluation \(E\) of the work or image?

We can arbitrarily posit the following relationship (equation 1), which states that the subjective evaluation of an image \(E = \) subjective overall quality is a function of the number \(n\) of inherent qualia \(Q\) that are considered to compose the work, whereby each quale has a value \(g\), which is a measure of its integrity or goodness and a value weight \(w\), which determines its relative importance for the work (values for \(w\) and \(g\) can be conceptualized to be on a scale, e.g. from 1–10, 1–100, see below).

\[
E = \sum_{i=1}^{n} g_i w_i Q_i
\]

We have arbitrarily presented a simple additive effect of the multiple qualia on the overall evaluation. Such an additive relationship could hold, for example, for the purpose of comparing different works with each containing the same number of qualia, such as multiple works by the same producer. Different goodness values \(g\) and weights \(w\) for identical qualia would then decide different degrees of the overall evaluation of the compared works. However, a simple
additive relationship cannot hold for comparisons between works with different overall numbers of qualia, since it would imply that the greater the number of qualia experienced, the higher the overall evaluation would be. We must consider this to be unlikely as a general law, since it would imply that simply adding qualia to a work would improve/increase the $E$ of a work, which cannot be true.

Therefore, we must assume some kind of limit to the maximum level possible for $E$. Consequently, for purposes of comparing images or works with divergent numbers of qualia, (p.482) we postulate a limit to the maximal possible $E$ for any particular work. For this purpose, as a first approximation, we posit that not the sum, but the average or mean of the number of qualia and their properties determines the overall $E$, by dividing sum by the total number of qualia ($n$), as in equation 24.2:

$$E = \frac{1}{n} \sum_{i=1}^{n} g_i w_i Q_i$$

We have also arbitrarily stated a multiplicative relationship between $w$ and $g$ of a quale, whereby the value of each in goodness ($g$) is multiplied by the value of its weight or importance ($w$). Another perhaps more reasonable relationship could be, for example, an additive one, whereby the rating of goodness ($g$) of a quale is added to the value of its weight ($w$) as in equation 24.3:

$$E = \frac{1}{n} \sum_{i=1}^{n} (g_i Q_i + w_i Q_i)$$

We could hypothesize other more complex relationships between the individual $Q$ in their influence on $E$. For example, one could argue that the whole is more than the sum or mean of its separate parts, a reasonable assumption which will have to wait for an adequate formula. However, as we discuss below, the qualia that are high in goodness and importance interact, harmonize, and compete to create the “whole” $E$ (see section 24.9). Thus, the result of the interaction between qualia in terms of synchrony, harmony, etc., can become by itself an important quale.
In the meantime, in order to illustrate the usefulness of this type of model, we will continue to employ the multiplicative relationship between \( w \) and \( g \) as expressed in equation 24.2 as a basis for our argumentation.

Models as we have presented them can be useful for conceptualizing relationships between variables. However, a model will have significant utility only if it can be tested and disproven and eventually be adapted to empirical reality. As we will argue later, this model may have such heuristic value in making empirically testable predictions regarding the evaluation and composition of works of art.

In an experimental test of the relationship between qualia in deciding \( E \), posited above, one could query a viewer as to, for example, which qualia are inherent in the work, and to rank individual discernible \( Q \)s in terms of their importance (\( w \)) and goodness (\( g \)) via a rating scale of, say, between 0–10. Works of art such as a painting or photographic image can surely be analysed or discussed in terms of the weight and goodness of perceived \( Q \)s. One can thus, systematically fragment and decompose the image or work—dismantle it by identification of its functional (perceived) qualia.

Such a systematic dissection of a work could also be performed in the service of testing the validity of the relationships postulated here. For example, it would be possible to test the utility or validity of the formulae empirically by comparing the evaluation of raters on a scale based simply on their intuitive appeal and one based on explicitly defined parameters of qualia inherent in the formulae. The degree of concordance between these evaluations could be a basis for hypotheses as to how to improve the formulae to improve the approximation of “reality” in aesthetic judgment.

24.3 Violation and extraction of qualia

We can now ask how the evaluation \( E \) of an image would be influenced by the elimination of or damage to a particular quale—\( Q \).
From the formulae above it follows that the smaller the number of Qs that comprise an image, the more dependent is the overall appraisal (E) of the work on the integrity (g) and weight (w) of its individual components. Conversely, as the number of Qs in a work increases, the less impact will w and g of any individual quale have on the overall subjective evaluation. (This prediction is independent of whether we take the overall number of Qs or the mean number of qualia to constitute E, and independent of whether the relationship between w and g is additive or multiplicative.)

The relationship between the relative weight of an individual Q to the total number of Qs in a work: we hypothesize that the number of Qs in a work will also determine the relative weight of each in deciding the overall E. Thus, we should adapt the equation to account for this relationship, which is likely to be an inverse correlation between number of Qs and their individual weights.

We can now ask as to the influence on E of eliminating or damaging a particular quale. We postulate that the subjective evaluation E of an image that has been modified by the extraction of a quale Q (x, with x = 0, ..., n), will be a function of the number, integrity, and weight of the remaining Q relative to the original total number of defined Qs and their integrity and weight. This relationship can be expressed as follows in equation 24.4:

\[
E = \frac{\frac{1}{n} \sum_{i=1}^{n-x} w_i Q_i}{\frac{1}{n} \sum_{i=1}^{n} w_i Q_i} = \frac{\left(\sum_{i=1}^{n-x} w_i Q_i\right)}{(n-x)} \times \frac{n}{\sum_{i=1}^{n} w_i Q_i} = \frac{n \sum_{i=1}^{n-x} w_i Q_i}{(n-x) \sum_{i=1}^{n} w_i Q_i}
\]

It follows from this relationship that the more qualia that are inherent in a work, the more resistant will be the value of E to an extraction or violation of any particular Q, since more Qs are left over to “carry” the image (i.e. its level of evaluation E). Conversely, the smaller the number of Qs in the image, the more vulnerable will be the residual overall evaluation of the work E to elimination or violation of any individual quale. The same holds for the violation of a particular Q in a work due to
Aesthetic Evaluation of Art: A Formal Approach

a low level or failure of goodness $g$ or impact $w$: that is, the fewer the definable Qs in a work, the more impact will any particular Q have on $E$. Therefore, a low value of $g$ and/or $w$ of any Q will have a more critical influence on $E$ than in a work that is characterized by a higher number of qualia.

We can perform virtual as well as real experiments to test the predicted relationship between number of Qs and the impact of modifying or eliminating a particular quale on the evaluation of the work. For example, we could change the characteristics of an obvious source of a quale in works composed of relatively large numbers of associative Qs (Hieronymus Bosch) and compare the relative effects on the evaluation $E$ with the influence of a violation of a Q (e.g. color) in minimal artworks (e.g. by Barnett Newman or Ad Reinhardt) that contain fewer obvious discernible Qs. Equation 24.4 predicts that the evaluation of a minimalist work will be influenced more by such a violation or extraction of a Q. A greater impact of a violation of a Q in art which is characterized by the use of few but powerful Qs would actually imply a higher degree of difficulty in creating such work in comparison to work embellished with more Qs.

In fact, Greenberg has espoused the deliberate refusal of particular qualia and the systematic delimitation of such in the development of Modernism (Greenberg 1961). His analysis of the gradual development of Modernist art can be seen in terms of the dispensing with of traditional qualia, such as three-dimensionality. Painting, he states, has made itself abstract and achieved autonomy by divesting itself of everything it might share with sculpture; painting should be self-critical and address only its inherent properties or Qs, namely, flatness and color.

Looking at the content of art from the standpoint of its Qs can contribute to an understanding of the work independent of the language used in descriptive analysis. For example, minimal art has been defined as being the maximal expression of formalism by its elimination of emotional elements (Qs) characteristic of Informal art and abstract expressionism. Such works can be characterized as (1) containing few
discernible Qs beyond the simple formal ones (e.g. proportion), (2) devoid of Qs with common associative properties and the accompanying emotional effects, and yet, (3) containing abstract Qs that may be difficult to label, other than with descriptors such as “purity,” “spirituality,” “peacefulness,” “simplicity,” “elegance,” etc., which may have emotional components, but not of the kind associated with everyday meaningful and identifiable concepts, ideas, objects, or events. The achievement of this category of Qs may define the teleology of minimalism. A similar analysis applied to other art forms will most likely arrive at different categories of dominant Qs that define it as a style or direction of art.

24.4 Taxonomy of qualia

Such an individual analysis of an artwork can encompass (1) “simple” basic qualia, such as color, size, brightness, texture, and grain, brushstroke, transitions—technique; (2) emotionally loaded Qs related to novelty, conflict, beauty, and the standard emotions such as love, hate, disgust, fear, desire, and laughter; (3) the formal compositional Qs, such as form, space, perspective, balance, harmony (or disharmony) that are taught as fundamental tools of the craft; (4) Qs with associative value of items or ideas, based on representational and figurative content; (5) Qs derived from the flow, interaction, and balance between concurrent Qs (see section 24.9), and (6) the “higher order” poetic, aesthetic, philosophical, ideological, and spiritual Qs. It should be possible to establish a classification scheme of the types of Qs to be found in images or works of art and on that basis describe artworks “objectively,” independent of epochs, “schools of art,” and content descriptors.

24.5 Viewing art on the basis of qualia

We will from here on use the term qualia rather loosely to refer to particular attributes or qualities of a work of art or architecture. The notion of qualia can also guide us in understanding the development of a work of art. To illustrate such an approach, we can take an actual example of a work of art and trace its development in stages to finality, as the artist
defines it. The first two images in Figure 24.1 present actual steps in the course of the production of a work of photographic art (there were many other steps in between these). In the top left, the picture is still structured in layers (the plastic ground, the red surface, blue surface, and back wall). In step 2 (top right), the focus is on the red-plus-blue surface and the scaffold in between giving the structure more monumentality. In the final version below, the structure is lower and appears heavier, whereas the space is clearer and takes on a function in the picture, and the numbers become important in filling the space and defining the background. We can see the progressive flattening of the image approaching that of a painting. Whereas the steel scaffold and the colors remain invariant, major changes lie in the surface of the base perhaps to approximate an impression of water, the adjustment in hue of the colors and the proportions of the elements to each other and the frame. We can, on the basis of this progression infer some of the invariant Qs in the artist’s a priori intentions.
24.6

Eliminating a Q

We can also perform *post hoc* experiments and violate qualia in works of art and assess the influence on our evaluation. For example, in Figure 24.2 we extracted the postcard from the center of the photograph. We can see that its removal has a profound effect on the image in terms of balance, proportion, depth, and color—fundamental Qs in artworks. However, the extraction also influences other more subtle Qs in this work: The postcard takes up various central themes in the picture, for example, art-historical Qs—the postcard is of a painting by Jan Vermeer and is dominantly positioned in an arrangement where there are various references to art, music, and literature. Aging as a Q—the postcard is yellowed and creased and the other objects are similarly dusty and used. The hat—
the lady wears a red, fluffy, elegant hat at an angle; the baseball cap is blue, hard-rimmed, and common and at an angle on the books. Overall poetic elements (Qs) are influenced by the extraction of the postcard. We have also violated important Qs in two architectural masterpieces in Figures 24.3 and 24.4.

Figure 24.2 Extraction of part of a photograph by Christopher Muller, Studio, 2012 (69 × 95 cm), top: original, bottom: defaced. © Christopher Muller.
We can now ask whether and how the violation or elimination of one $Q$ will influence the poignancy and weight of the remaining $Q$s and the overall evaluation $E$. Equation 24.4, as a first approximation, is based on the simplified assumption that after a deletion of any individual $Q$, the values $g$ and $w$ of the remaining $Q$s stay the same. An alternate and more valid
assumption might be that after elimination or subtraction of a quale \( x \), the \( g \) and \( w \) values of the remaining \( Q \)s will change, with the consequence that the overall \( E \) might even increase, instead of always decreasing as in equation 24.4. Such a relationship can be expressed in the manner shown in equation 24.5. Here \( y = n - x \), the number of remaining qualia \( Q \); \( y_0 \) = the original state; \( x = 0, \ldots, n \), the number of extractions: \( g_i \) and \( w_i \) are a function of \( y \).

\[
(24.5) \\
E(y) = \frac{\frac{1}{n} \sum_{i=1}^{n} g(y)w(y)Q_i}{\frac{1}{n} \sum_{i=1}^{n} g(y)w(y)Q_i} = \frac{\sum_{i=1}^{n} g(y)w(y)Q_i}{(n - x) \sum_{i=1}^{n} g(y)w(y)Q_i}
\]

24.7 Rapport between producer and viewer

Interestingly, we can employ our basic model to also account for the “failure” or “success” of a work of art. For example, a lower evaluation \( E \) given by the viewer than that expected by the producer can be a result of a discrepancy between the qualia that are intended/perceived by the artist and perceived by the viewer. Accordingly, the bigger the discrepancy between the evaluations of artist and viewer, the less likely it is that the work will be “understood.” We can measure the degree of dissonance between viewer and producer by taking equation 24.4 and making a ratio between the evaluations of the producer \((p)\) and viewer \((v)\):

\[
(24.6) \\
dEs = Ep/Ev
\]

This relationship is shown in equation 24.6, whereby the ratio between the evaluations \((Es)\) of the producer \((Ep)\) and viewer \((Ev)\) provide a metric of the discrepancy \((d)\) between these, namely \(dEs\). The degree of proximity to value 1 provides the measure of rapport between producer and viewer. A divergence between the \(E\) values of producer and observer can be a result of different \(w\) and/or \(g\) of the same \(Q\), or to different \(Q\)s recognized by producer and observer. Of course, this measure of dissonance or concordance is applicable to
comparisons between any other populations, such as between “expert” and “naïve” viewers.

24.8 Invariance of qualia

As we have already stated, we assume that when we view a work we consciously or subconsciously assess it on the basis of qualia and their interactions. With experience we may become familiar with the criteria for goodness (quality) and importance of the qualia as dictated by the experts (e.g. the market, critics, artists). Which Qs are discerned in a work and how they are weighted and evaluated are, of course, influenced by cultural, political, historical, theoretical, and contextual variables. Bullot and Reber (2013) have admirably compiled and categorized the environmental, social, and historical factors that determine the viewer’s detection and evaluation of qualia and their properties in works of art.

In spite of the great number of possible sources of variation and the presumed subjectivity involved in the response to complex displays, there can be a remarkable degree of concordance and agreement in the evaluation of art objects and in the extraction of qualia and their relative impact. Such consensus is undoubtedly the result of acquired notions, common history, and cultural influences, marketing pressures, and suggestion. However, there is also evidence for genetic variables that dispose the viewer to recognize, value, or avoid attributes of images. How we perceive and evaluate objects in the world is partly determined and limited by built-in physiological mechanisms that have developed in accordance with evolutionary and ecological pressures with survival functions. These can be built predispositions in the perception of and responses to relatively “simple” qualia such as proportions, balance between elements, color combination, novelty, etc., but also to more complex information such as object and action categories (e.g. Brown et al. 2011; Huth et al. 2013; Ishizu and Zeki 2011; Zeki 2000).

Since, as we have stated above, $E$ can be influenced by innumerable variables, including context, history of exposure, and current state variables of the viewer (e.g. time of day, transient mood, concentration level, health), we can ask to
what degree a measure of $E$ can be reliable; that is, what is the variability in the measure of $E$ with repeated viewing of the same display by the same observer? We can also ask about the concordance of $E$ within a particular population of viewers; to what extent does a sub-population concur in the inherent qualia and eventual $E$ of a work and how consistent is such a population $E$? We could hypothetically as well as empirically also compare the mean $Es$ of different subpopulations of viewers (e.g. based on levels of education, demographics, etc.). It should also be possible to detect invariance in the properties of works by the same artist, to identify $Q$s that define or characterize the oeuvre of a particular artist or class of artists. An example of how an individual artist’s work can be discussed on the basis of idiosyncratic $Q$s has been carried out elsewhere (Huston 2002a, 2002b).

24.9 The problem of concurrent qualia: poignancy, fading, and interplay of $Q$

If the perception, registration, and judgment of a work are a function of the actions of its multiple qualia on the observer, we must ask whether and to what degree multiple parameters, attributes, or characteristics of a display can be simultaneously processed to result in the $E$. We cannot rule out the possibility that the nervous system can simultaneously process different qualia in parallel. Even if we accept this possibility, we can ask whether a viewer can simultaneously also attend to multiple $Q$s in an image or work (whether consciously or unconsciously).

24.10 Poignancy

To address the issue of the processing and impact of multiple concurrent $Q$s on the observer, we can make the following assumptions or hypotheses: (1) qualia with high values of weight ($w$) will predominate over $Q$s with relatively low weight in poignancy. Accordingly, the probability of a quale having an impact on the observer will correlate with its weight. (2) Similarly, qualia with high quality or goodness ($g$) will predominate over $Q$s with low values of $g$ and, as with weight,
will have a hierarchical probabilistic advantage correlated with goodness. (3) As we have posited an interaction between \( w \) and \( g \) in determining the value of judgment \( E \), it follows that this interaction (in our case stated arbitrarily as multiplicative) provides a compound measure with a relative probability in terms of relative dominance over other \( Qs \) in the impact on the observer, which we can designate as poignancy, a \( Q \) in itself which will determine processes related to detection of and attention to the \( Qs \).

As we have emphasized, the fewer the number of \( Qs \) in a work or display, the more important each individual \( Q \) will be in deciding overall \( E \), and most likely, the more poignant it is, the higher will be its weight; that is, the number of \( Qs \) in a work will also determine the relative weight of each in deciding the overall \( E \). Also, in reference to the earlier section on violation of \( Q \) and equation 24.5, we emphasize that violation or manipulation of one \( Q \) is likely to influence the weight and poignancy of the remaining ones, with a probable effect on total \( E \).

24.11 Fading or decay of \( Q \)

We hypothesize that an attribute of any stimulation will not remain invariant over the duration of viewing. Thus, although the poignancy of a \( Q \) may increase as a function of enhanced recognition and attention to it, it is also likely to fade or decay with time of observation. Such fading of \( Qs \) can be a consequence of habituation, satiation, fatigue, and boredom, or due to shift in attention to competing \( Qs \). Such processes are well known to influence perception and can occur at various levels of the nervous system, including the basic receptor level, such as the retina. The issue of fading qualia has also been treated by Chalmers (1995).

We posit that each \( Q \) has a specific rate of decay or fading. The rate of decay determines its dominance over competing \( Qs \) over the time of viewing (as well as its interaction with \( Qs \) that replace it)—see section 24.12. The rate of decay of a \( Q \) is likely to be related to its combined weight and goodness. Furthermore, the rate of fading is also likely to be a function
of the competing Qs in the work; that is, the fewer the competing Qs, the slower should be the rate of decay. Such fading of Qs is related to processes of “attention”: the viewer’s attention may shift to competing Qs. It follows that the fewer competing Qs there are, the less likely that attention will shift and the fewer Qs to which can attention be shifted.

Such fading allows a second-level Q to assume a higher level of poignancy. As new dominant Qs also fade out, there will be an emergence of new and previously faded Qs. This process of substitution of Qs enhances the novelty of Qs and in itself provides an overall dynamic process, which may be considered to influence the overall impact of a work of art (or of any complex display) on the viewer. Thus, the subjective impact of a display is not a static all-or-none effect on the observer and on his or her nervous system, but a continuous process involving the flow of information of the Qs that define or constitute the experience.

24.12 Interplay of Qs

The concept or process of fading of qualia underlies an important form of interaction between Qs. Qualia can interact in several ways; for example (1) they may influence each other in powerful ways to create new compound Qs. Their virtual simultaneity can have additive properties to define a “whole.” (2) They also serve as each other’s context. (3) Due to the fading out we hypothesized above, we can postulate that interactions between Qs are not merely parallel, but also sequential and dynamic.

For example, in the case of an art object that is presented to the observer statically (painting, photography), an important process pertains to the interplay between Qs during the process of evaluating the image. Such an interaction between competing dominant Q can be conceptualized as a dynamic reciprocal flow between them that can perhaps determine harmonic properties of the work. When we confront an image our perception thereof is not invariant, but on the contrary, is determined by such a flow between the images’ Qs, whereby one or a set of such can dominate and recede in rapid
succession. For example, when viewing Figure 24.1, the associative elements or Qs, such as the impression of water or the steel scaffold, can predominate at one point in time, whereas compositional Qs (color, proportion) may dominate at another moment. Such a switching between component Qs can be “willed,” since we can consciously decide to focus on one or another, or it can be uncontrolled due to fading of Qs, as one quale displaces another in predominance. Uncontrolled switching between perceptual elements or Qs is illustrated by the well-known reversible figures of Gestalt psychology. Of course, the effect or memory of one Q will hereby influence the interpretation or effect of the subsequent Q. There are, deliberate goals in the visual arts to present the unitary “whole” in a work as one Q instead of as a composition of parts, particularly in so-called minimalist works, that attempt to reduce a concept to its simplest and purest form via a minimal use of geometric shapes, colors, lines, and progressions.

24.13 Qualia in architecture

For art forms that are dependent on temporal or sequential properties of Qs (such as music, architecture, and literature) or dependent on different perspectives for viewing (such as architecture and sculpture), the exact nature of the interaction between elements in their sequence and order can be critical. A work of architecture can potentially be seen from an infinite number of perspectives as it is four-dimensional (three dimensions in space plus time); one can enter the structure, traverse, touch, and use it. It cannot be viewed primarily from the standpoint of visual art. Architectural design can involve a string of logical and causally related sequential processes. Thus, the Qs in architecture can display a mutual dependency in terms of purpose and idea. The preservation of ideas and conceptual intentions throughout the process of design and building stages to the finished product is a major complex Q. The degree of understanding of these cardinal design ideas will strongly influence the evaluation of the product. For example, the process of employing as little as possible to achieve as much as possible is a major Q of minimalism in architecture, with the notion that “less can be more,” as fewer
Qs gain more weight in the impact of the whole. From this perspective architecture is more complex than, say, a painting as it cannot be evaluated in toto from one point of view. Its Qs include functional aspects, material, and tectonic elements, aesthetic as well as contextual properties. Parts of a building have specific functions which can be viewed in isolation but also in relation with the other sections of a building, its environment, and history. Consequently the possible bases for evaluation can be complex or simple, depending on the viewer’s focus (on the primary poignant Qs).

We will here examine some architectural Qs with examples taken from different architectural traditions.

24.14 Antique

To consider just one Q, namely proportion, as emphasized around 25 BC by Marcus Vitruvius Pollio in De architectura:

> Proportion is a correspondence among the measures of the members of an entire work, and of the whole to a certain part selected as standard. From this result the principles of symmetry. Without symmetry and proportion there can be no principles in the design of any temple; that is, if there is no precise relation between its members as in the case of those of a well shaped man.

(Vitruvius 1914)

Proportion in architecture refers to the ratio of the length, width, and height of a building, a façade, or a component. The Parthenon in Figure 24.3 illustrates the importance of proportion in classical architecture and the effects of violating such in width and height (see also section 24.1 on the golden ratio (φ), as a basis for architectural proportion and aesthetics). We would predict that the mean E of a set of observers will be higher in value when presented with the proportions of the original (Figure 24.3, top) than those of the modified Parthenon (bottom). In the middle image we changed the number of columns from eight to the uneven nine, which also influences the overall proportions of
the building and eliminates the central space, which is an important Q in ancient Greek architecture. In architecture the proportions are closely related to structural variables such as the loads or forces applied to a structure or its components. These variables, which influence the necessary thickness of walls, columns, and floors, depend on building materials, regional, (p.494) historical, and intentional variables (compare the proportions of the Parthenon with those of Mies van der Rohe’s Pavilion in Figure 24.4).

24.15 Classical modern

The Bauhaus, founded by Walter Gropius in Weimar, Germany (1919–1933) propagated the avant-garde of Classical Modernism in all of the free and applied arts. One of its guiding principles (Q) was the creation of a “total” work of art, a “Gesamtkunstwerk” in which all of the arts, including architecture, would eventually be brought together. Modular elements came to be employed in industrial structures and for creating affordable housing (major Qs being industrial prefabrication, simple, cost-efficient manufacturing). In his Vers une architecture, Le Corbusier proclaimed the principles of the “New Architecture” to be based on functionality, with an aesthetic based on pure form (Le Corbusier 1927). His buildings, starting with Villa Savoye in 1931, exemplify his five principles (Qs) of architecture; for example, Q1, the main building is often separated from the ground, supported by concrete stilts, allowing Q2, a free façade with non-supporting walls, and Q3, an open floor-space. In the upper floors he employed large windows providing a wide-open view (Q4). Roof gardens compensated for the greenery that was displaced by the building (Q5). Le Corbusier also followed the use of the golden ratio Q blended with human proportions in his buildings. An example of the new architecture is Mies van der Rohe’s Pavilion in Barcelona (Figure 24.4): the qualia in this work are not only visual, but especially of a conceptual nature. Free-flowing, open spaces were made possible by the removal of load-carrying exterior and interior walls and the use of slim, steel columns. The bottom of Figure 24.4 shows the effect of replacing conventional outer walls and roofs to this building.
24.16 Minimalism

Minimalism has been practised in the past inter alia in Japanese architecture, following ideas of Zen philosophy or the Japanese “Ma” (negative space). Modern minimalism evolved from the Bauhaus school which adopted Zen ideas of a radical stripping down—ridding of ballast and excess information not germane to the main naked structure, message, and composition. As stated earlier, the common denominator of minimalism in the fine arts, literature, and architecture is to focus on the “essence” of a work—its abstract quality via the elimination of superfluous concepts and items. The emphasis in architecture was on Qs of simplicity, basic geometric forms, cold and hard lighting, open living spaces, minimal use of materials, objects, and decoration, with the intention to reduce to the point where no further reduction could add to the concept. Note the aphorisms “less is more” (Mies van der Rohe) or “less but better” (Dieter Rams), by which the simplest and fewest elements are to be applied to produce a maximum effect. A great deal of attention came to be focused on clean spaces, natural light and air in interaction with the inhabitant to achieve abstract qualities (Qs) related to essential harmony, order, and simplicity, independent of tradition and historical burdens. Contrasting Wang Shu’s minimal Ceramic House with Frank Gehry’s Art Museum in Figure 24.5 highlights the obvious important Qs in minimal architecture. Gehry’s building is highly compositional (like a Cubist painting) with Qs of balance and the questioning of balance in form, light, shadow, and statics. It exemplifies modernist tendencies to Qs of individualism, freedom of expression, and technological experimentation. Its parts could be arranged differently without sacrifice; its design process is formal—from outside to inside—in contrast to Shu’s design, which is causal and conceptual. The former design might invoke more sensual emotional Qs in the viewer than Shu’s with its emphasis, on the one hand, on conceptual intellectual mathematical Qs and, on the other hand, on Qs related to serenity, purity, the spiritual, the sublime, the poetic. Which brings us back to equation 24.4 and the prediction that the smaller the number of Qs in a work, the more vulnerable will be the residual
overall evaluation of the work $E$ to elimination or violation of any individual quale, and we can speculate as to which of these two works could more likely withstand an extraction or defacement of a $Q$.

As emphasized earlier, such considerations and goals hold also for expressions of minimal art in painting, music, film, literature, and theater, where minimalism can be contrasted with past art forms often cluttered with decoration, symbols (of religion and power, etc.), information, and facade. “It isn’t necessary for a work to have a lot of things to look at, to compare, to analyze one by one, to contemplate. The thing as a whole, its quality as a whole, is what is interesting. The main things are alone and are more intense, clear and powerful” (Judd 1965).

(p.496) We can now refer back to equation 24.4, which predicts an inverse relationship between the impacts of $Q$s in relation to their total number in the evaluation of a work, and ask whether this formulation does not provide a mathematically based “explanation” for the appeal of minimalism in art and architecture independent of the prevalent ideological/psychological rationales presented above. It follows that the equation would also allow comparisons between different art forms, such as schools of art, based on relative number of inherent qualia. Such congruence between predictions from this model with the reality of human evaluation argues, both, for the heuristic value of such modeling and for the utility of the concept of qualia in accounting for art evaluation.
24.17 How does the brain process qualia?

As part of a collection of essays on aesthetics and the brain, this chapter should attempt to relate our approach to aesthetic evaluation to the prospect of eventually being able to understand the neurophysiological mechanisms that must underlie the processes of perception, recognition, and evaluation of qualia as espoused in our model. How can the nervous system cope with such complex processes and how can we hope to discover the physiological bases for these processes? Each $Q$ extracted from an image constitutes a separate complex representation in the brain at the moment of its recognition. If our viewing and evaluation of a complex image depends on the interplay between individual attributes or $Q$s of an image, our nervous system must possess the mechanisms necessary to attend to, encode, recognize, store, and respond to such representations. Some of the required mechanisms involved include attention to the image, its registration and recognition, plus the processing of associative, emotional, reflective, and evaluative responses to the image. A vast research effort is engaged in delineating the anatomical, physiological, molecular, and genetic mechanisms involved in each of these categories of

central nervous system information processing, which, in toto, encompass the totality of neuroscience research, which subsumes many highly specialized disciplines. It can be expected that as these individual mechanisms become known, it will be possible to extrapolate to what happens in the brain during confrontation with and response to an image.

In section 24.4 we presented a rough classification of Qs based on (1) “simple” basic stimulus properties; (2) emotional Qs; (3) formal compositional Qs; (4) Qs with associative value of items or ideas; (5) Qs, related to interaction between concurrent Qs; and (6) “higher-order” Qs. For our purposes it may be useful to attempt to relate these categories of Qs to known major separable central neurophysiological subsystems involved in information processing. Some progress in understanding processes involved in our first three categories can be attributed to imaging experiments. The main contribution so far has been in analyzing aesthetic preference, that is, in discerning between “liked” versus “less liked” presentations on the basis of activation of corresponding structures in the brain (summarized in Cela-Conde et al. 2011). For example, neural activity can be registered in various brain areas while observers rate aspects of the presentation (such as “beauty” or symmetry) on some scale and such studies have identified structures activated during evaluation of preferred images, such as the orbitofrontal cortex (Kawabata and Zeki (p.497) 2004), left dorsolateral prefrontal cortex (Cela-Conde et al. 2004), left anterior cingulate gyrus and bilateral occipital gyri (Vartanian and Goel 2004), and fronto-median and anterior cingulate cortex (Jacobsen et al. 2006). Given the realm of Qs that can comprise the evaluation of images, reducing aesthetics to the experience “beauty” is, of course, a gross oversimplification of what will be required to account for the experiences derived from, for example, visual images or works of art. “Beauty” represents an overall evaluative response to an image and probably subsumes emotional properties related to bliss, joy, and reward, but the concept masks the constituent elements (Qs) and processes that lead to such a response, and which must be the objects of an ultimate neuronal accounting for aesthetics.
Several attempts have been made to delineate the sequence of brain areas activated during the presentation of an image with some success in identifying different areas engaged within milliseconds of exposure in correlation with processes of registration of, attention to it, aesthetic evaluation of, emotional response to, and engagement with the presentation (Chatterjee 2004; Jacobsen and Höfel 2003). Other brain imaging studies have focused on neural systems involved in recognition processes, the role of the brain’s reward system, emotional responses, and the role of experience in viewing artworks (summary in Cela-Conde et al. 2011). A meta-analysis of neuroimaging studies of positive-valence aesthetic appraisal led to the hypothesis that a system for aesthetic processing initially evolved for appraising objects with survival value (e.g. food) and was later co-opted in humans for aesthetic experience to satisfy social needs (Brown et al. 2011).

A number of studies have also dealt with the question of how object and action categories are represented in the brain. For example, functional magnetic resonance imaging (fMRI) was used to measure brain activity elicited by presentation of movies in order to investigate the cortical representation of 1705 different object and action categories (Huth et al. 2013). The authors reasoned that, given the vast number of such categories humans can recognize, the limited size of the human brain would preclude the possibility that every single category is represented in a specific brain area. Accordingly, they found that object and action categories are represented in a semantic space consisting of at least four dimensions, and that this space is organized into smooth gradients covering most of the visual and nonvisual cortex. The cortical organization of this visualized semantic space was invariant across different individuals. Thus, the brain represents object and action categories into a continuous space onto the cortical sheet so that adjoining points in the cortex represent semantically similar categories. However, other studies have shown that some categories of objects and actions are represented in specific cortical areas, such as for faces (Rajimehr et al. 2009), body parts (Peelen and Downing 2005), and outdoor scenes (Epstein and Kanwisher 1998). A large effort is dedicated also to understanding how conscious
perception evolves following presentation of a stimulus (Van Rullen and Koch 2003) and the mapping of brain regions responsible for the encoding and retrieval of semantic and perceptual associations (Prince et al. 2005).

Although some progress has been made in identifying brain systems involved in viewing and evaluating images, a major challenge for the area of neuroaesthetics research relates to the competition between different qualia that comprise the perception and evaluation of the image. We postulated earlier that qualia fade in and out as the viewer habituates to one or tires of it. Potentially, the kind of semantic organization of categories in the brain as demonstrated by Huth and colleagues (2013) can provide a basis for investigating how the brain handles such processes—the rapid activation and alteration of representations of different classes of qualia. However, the brain’s response to presentation of a display involves many separate neural systems with a continuous interaction between the perceptual, mnemonic, associative, attention, and emotional systems. An ultimate understanding of the brain’s role in perceiving and responding to a complex display with multiple Q will have to invoke all of the systems involved in conscious and unconscious perception, information processing, emotional response, and internal mentation.

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