

The Artful Mind

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<http://theartfulmind.stanford.edu>

Full color images to accompany this book are presented on the web at <http://theartfulmind.stanford.edu>. The site additionally presents supplementary documents, a history of the research activity surrounding this volume, and notes on further activities and research on the artful mind.

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Introduction Chapter by Merlin Donald: Art and Cognitive Evolution

Headnote: The chapter offers an overview of the cognitive principles of art, the origins of art, and the cognitive function of art. Art is an activity that arises in the context of human cultural and cognitive evolution. Its sources include not only the most abstract integrative regions of the brain but also the communities of mind within which artists and audiences live. The interaction of these sources creates complex cultural-cognitive structures, which are reflected in art. Art and artists are elements in evolutionary development.

In this chapter, I use the word *art* to refer to a wide class of expressive forms and media, including music, dance, theater, various multimedia categories (such as opera and cinema), painting, sculpture, aspects of the built environment, and architecture. The word can reasonably be extended to include most forms of written literature. I do not include any of the broader applications of the word *art*, as for instance the *art* of mathematics, engineering, baseball, or carpentry. It may be said that there is an *art* to performing virtually any activity elegantly or well (including art: there is an *art* to good art, one might say), but that is another matter. Here I am concerned with the origins and functions of artistic forms and media themselves, rather than with issues of artistic creation, merit, beauty or transcendence.

What cognitive principles govern art? And where should we begin a cognitive exploration of its origins? There is no consensus on this, but a few guidelines might help establish the territory to be explored.

1. Art should be regarded as a specific kind of *cognitive engineering*. As a first principle, art is an activity *intended to influence the minds of an audience*. It involves the deliberate construction of representations that affect how people (including the artist) view the world. This reflects a very deep human tendency for the reciprocal control of attention, which carries with it a tendency to deliberately *engineer* the experiences of others (especially of our own progeny and peers). Joint and reciprocal control of attention is the foundation of human social communication, and just as parents guide their children's attention to certain aspects of the world, most artists attempt to control their audience's attention, leading it by the hand, so to speak, into a carefully engineered experience. To achieve this, the artist must be an effective pedagogue, anticipating the audience's reactions (this principle applies even if the artist wants to elicit an apparently unpredictable result, in which case, of course, uncertainty itself is engineered into the outcome).

2. Art is always created in the context of *distributed* cognition. Human cultures can be regarded as massive distributed cognitive networks, involving the linking of many minds, often with large institutional structures that guide the flow of ideas, memories, and, knowledge through the cultural-cognitive network. Artists work within various subsystems of those broader networks; they are situated in space and time, defining themselves as members of a specific tribe and generation. They may influence the cognitive activity of their tribe, by influencing and modifying its symbols, images, and other expressive forms. Thus, they are workers within the network, highly placed within the distributed cognitive system. They serve as keepers, preservers, and often, as the

creative engine that drives much of the enterprise. In a sense, they are one with the network, are completely dependent on it, and derive their most basic ideas and techniques from it, as well as the inspiration and limitations it imposes.

3. Art is *constructivist* in nature, aimed at the deliberate refinement and elaboration of *mental models* and *world-views*. These are the natural products of cognition itself, the outcome of the brain's tendency to strive for the integration of perceptual and conceptual material over time. The term "large-scale neural integration" refers to the nervous system's inherent tendency to do this kind of cross-modal integration, that is, to unify many sources of experience into a single abstract model or percept. The canonical example of this tendency is event-perception, which can unify a blur of millions of individual sensations of sight, sound, touch, taste, smell, and emotions into unitary event-percepts. This ability is very limited in simple organisms, where the "stimulus" of behavior is often an uncomplicated one-dimensional property, such as a pheromone or a color, but it is common, and very highly developed, in most social mammals and especially in human beings, where it has evolved into a very abstract capacity able not only of integrating the raw materials of experience, but also those of memory itself. Thus a dog is able to understand complex social events, such as "begging" behavior, or "submission," which involve socially relativistic percepts that unfold over time. Humans, of course, navigate much more abstract versions of social behavior, which culminate in world-views that frame their interpretation of events. Thus the Stoic, Scientific, Puritan, and Romantic world-views share a basis in the need to achieve abstract integration of smaller events. Such world-views are collective, or cultural, products of this shared drive toward integration.

Large-scale integration might be regarded as the major adaptive advantage conveyed by the complex of special brain capacities often labeled "conscious" processing (Donald 2001). As the nervous system's capacity for conscious processing evolved, selected species achieved increasingly more abstract kinds of cognitive integration, which gave an accordingly wider temporal and spatial range to their behavior. This ability gave those species the ability to perceive distant, complex, and very abstract aspects of the environment, such as social alliances, whose complexity exceeds the capacities of simpler creatures. In humans, this constructive integrative capacity evolved into a communally shared capacity of the group. Human culture is essentially a distributed cognitive mechanism, within which world-views and mental models are constructed and shared by the members of every society. Artists are traditionally at the forefront of that process, and have a large influence on our world-views and mental models.

4. Most art is inherently *metacognitive* in nature. Metacognition is, by definition, self-reflection. Art is self-reflective. The artistic object forces reflection on the very process that created it; that is, the mind of the artist, and thus of the society from which the artist emerged. Ultimately, art derives from the innate human capacity for self-observation, and that is why art has been so instrumental in defining cultural periods, and in providing tribes, of whatever size and complexity, with their self-identifying symbols and allegories. Art is thus inherently metacognitive in its cognitive function on both the individual and social levels. Unlike the customary use of this term to specify individual self-reflection, I refer here especially to art's role as a collective means of self-reflection, and a shared source of cultural identity.

At various points in human cultural history, artists and writers have built comprehensive metacognitive systems that served to reflect on society and human nature;

typical examples of this process are the complex pictorial representations of knowledge so common in Medieval European alchemy, and the many large Italian paintings that summed up the conventions of Renaissance social order. These artistic objects reflected the predominant mental models and world-views of those societies back to their members, and placed artists in a position of considerable metacognitive influence, even though they derived their material from the society itself. The power of the artists arose because they often subtly (and sometimes not so subtly) altered and influenced their images and world-views in a highly selective manner. The world-views of communities have often been permanently changed through the efforts of a single artist (e.g. Verdi's revolutionary impact on 19th century Italian politics). On such occasions, art sits high in the hierarchy of cultural-cognitive governance. Traditional religions realized this fact, and this explains their long-standing dependency on art. Modern secular states, such as Maoist China, have also realized the importance of art, and have used it in a similar way, as have modern corporations. This social-reflective role of art has always been controversial. But the ferocity of the arguments revolving around this topic testifies to the basic nature of the contribution that art makes to the collective processes of thought, memory and perception in society. This is evident in the art of Christianity, Buddhism, and Islam, which conveys highly formal, integrated world-views. It is also evident in the chaotic and fluid imagery of modern secular society, which conveys many different such views.

5. Art is a *technology-driven* aspect of cognition. It may have begun as a natural expression of our collective need to represent reality, but the media of artistic expression affect what can be represented, and these media differ tremendously between societies. The effect of technology on art is far-reaching. Technology affects the kinds of cognitive networks artists can construct, and sets limits on what kinds of ideas and images can be

created and represented. Major works of art constitute a crucial part of society's attempt to engineer, manipulate, and reflect on its own experience and occasionally to fabricate *de novo* its ideas and images. In historical context, technique and technology are central in defining what artists do, and what choices they can make. Moreover, technology can actually alter the properties of the distributed cognitive systems of society, and change the nature of the cognitive work that is done.

6. The role of the artist, viewed as a component in a distributed cognitive system, is not necessarily fixed. As the system goes, so goes the role of art, and indeed, the very definition of art. Elsewhere (Donald 1991, 2001), I have argued that symbolic technology (including the many technologies involved in making art) can deeply affect the architecture of cognition, both inside the head, and outside, in the social network. In particular, such innovations as writing systems, new graphic media, and external memory systems can change the kind of art, and the range of world-views, that are possible, *because they influence memory itself, through both the media of storage and the pathways of retrieval*. Symbolic technologies ultimately enabled Brunelleschi to build the dome of Santa Maria del Fiore in Florence. Similarly, they enabled Rodin to conceive of, and cast, his bronzes, while setting limits on what he could represent. Technology often determines the parameters of thought and creation (mathematical thought is a particularly clear example of this—mathematics is all about finding the right set of symbols to capture an idea).

This point has been largely missed in cognitive theories of art. When one is dealing with a distributed network of many individuals linked together, rather than an isolated individual, as a major source of creativity, the properties of the network, particularly those of network memory, become highly relevant. These are typically

affected much more by technology than the properties of biologically-defined memory in the individual, which are largely fixed in the genome.

7. Art is always aimed at a *cognitive outcome*. The conventional engineering, of, say, a bridge or drug compound is aimed at a specific physical outcome. In contrast, art is aimed at a specific cognitive outcome. It is designed to engineer a state of mind in an audience (even in cases of extreme narcissism where the only intended audience is the artist). The work is judged by its success in achieving this end. Thus, in its ends, art is essentially different from other kinds of engineering, because its purpose is primarily cognitive. Cathedrals, and films, are specific kinds of cognitive machines. Their major social functions are cognitive: they influence memory, shape public behavior, set social norms, and modify the experience of life in their audiences. In these terms, the various techniques and media of art are a small but important part of the larger evolutionary trajectory of the human mind.

Art viewed in an evolutionary context

Art is universal to all societies, and unique to humans. Inevitably, when a phenomenon is both universal and species-unique, the question of its evolutionary origins arises. Within the reach of evolutionary theory, human evolution is special, and unusually complex, because it entails the co-evolution of biological and cultural forces. Art is central to that process, and one of the most interesting phenomena of human culture.

The cognitive domains of human cultural and cognitive evolution have emerged in three cascading stages, which I have labeled, successively, as Mimetic (-2 million years ago) Mythic (-150 thousand years ago) and Theoretic (last 2 thousand years, approximately) (Donald 1991, 1993, 1998, 2001). [PROVIDE 1993 AND 1998 IN REFERENCES] These dates are only rough approximations; it is the sequence, rather

than the specific date, that is important. This progression is cumulative and conservative, with each preceding stage remaining in place, and continuing to serve its specialized cognitive function in human society, as each new stage emerges. Even though art is a relatively recent development in the long history of the human species, it has an investment in all these cognitive domains, and its many forms reflect the very rich cognitive accumulations of human culture. Indeed, in many instances art has been a major factor in evolving these domains, and constitutes our major evidence for examining the nature of prehistoric culture.

Because evolution is conservative, the modern mind retains all previous stages within its complex structure. Without elaborating on its definition, it might be said that the Mimetic domain refers mostly to gesturing, pantomime, dance, visual analogy, and ritual, which evolved early, and formed an archaic layer of culture based mostly on action-metaphor. This allowed for the spread of toolmaking technology and fire-tending through imitation and ritual, among other things. It also set the stage for the much later evolution of spoken language. Mythic culture is based on spoken language, and especially on the natural social product of language, storytelling. Most societies have a specific subset of stories that acquire the status of myths, and these have a governing role in defining how to behave in that culture. Myths also preserve notions of authority, gender, and morality. Mythic culture retains a subsidiary mimetic dimension, preserved in such things as ritual, costume, and gesture, which are epitomized in various forms of art. The mimetic dimension tends to fall under the governance of myth; thus the art and ritual of Christian civilization has been greatly concerned with the mythic content of that civilization. The same applies to Islamic, Jewish, Buddhist, and Hindu art. Traditional religion has often

been the core institution for the regulation of what might be called "high" mythic culture, and art has fallen under that kind of regulation in many societies.

Theoretic culture is a more recent historical development and has evolved very rapidly over the past few hundred years. It started very slowly, with the first emergence of sophisticated writing technologies and scientific instruments, and, after a very long gestation period, it became (somewhat) dominant in Western society, after the Enlightenment. Theoretic culture is symbol-based, logical, bureaucratic, and heavily dependent on external memory devices, such as writing, codices, mathematical notations, scientific instruments, books, records, and computers. It is the culture of government, science, and technology, and of many forms of art. In a global context, relative to the influence of the mimetic and mythic domains, theoretic culture is still a minority culture. However, it is disproportionately influential because of its place in the distributed cognitive systems that determine such things as our collective representation of the past, and our tribal and class identities. Of necessity, even theoretic institutions retain a mimetic and mythic element, because human society cannot function without these more basic forms of representation, which carry out specific kinds of cognitive work. Whereas theoretic modes of thought are dominant in planning, science, technology, and government, mythic and mimetic forms continue to dominate the vast majority of human transactions, including those that take place in the political and interpersonal domains.

Even though art is a relatively recent development in the long cognitive history of the human species, its forms reflect all these cognitive and cultural domains. The diversity of art, and its modern proliferation of forms, reflect the rich historical background of modern cognition and culture. Table 1 illustrates this point, by mapping various current artistic forms onto the proposed major cognitive domains of human cultural-cognitive

emergence. Note that this process is cumulative and scaffolded. By implication, the breakthrough adaptation, and the one from which all else about the human mind follows, is mimesis. The strong form of my hypothesis about art might be phrased as follows: the new is always and inevitably scaffolded on the old and, as a result, art is ultimately a reflection of the deepest and most ancient form of human expression, mimesis. This hypothesis is discussed further in a later section.

EXTERNAL FORM	COGNITIVE DOMAIN
Pantomime	Whole-Body Mimetic
Prosody, Chant	Vocal Mimetic
Most Rituals	Whole-Body And Vocal Mimetic
Acting, Body-Language	Facial, Vocal, Whole-Body Mimetic
Costume, Dress, Makeup	Technologically Amplified Mimetic
Most Styles Of Painting	Visual Mimetic
Sculpture, Crafted Objects	Visual, Tactile, Kinematic Mimetic
Popular Music	Auditory Mimetic
Oral Storytelling	Linguistic/Mythic
Epic Oral Poetry	Linguistic/Mythic
Lyric Poetry	Linguistic/Mythic
Novels, Other Extended Narratives	Linguistic/Mythic
Traditional Architecture	Mimetic/Mythic
Comic Books, Cartoons	Mixed Mimetic/Mythic
Formal Public Ritual And Spectacle	Mixed Mimetic/Mythic
Cinema, Opera, Theater	Mixed Mimetic/Mythic
Modern Architecture	Mixed Mimetic/Mythic/Theoretic
Modern Painting	Mixed Mimetic/Mythic/Theoretic
Modern Poetry and Music	Mixed Mimetic/Mythic/Theoretic

Table 1

Art, neuroscience, and distributed networks

Before embarking on this section, I should point out a caveat about the uses of neuroscience in this kind of very broad cognitive theorizing. All things cognitive are ultimately products of brain activity. It may seem to follow that art is cognitive, and therefore a straightforward product of brain activity and that, to understand it, we need only to track its origins to some specific kind of brain activity, such as the neural systems

underlying human vision or human mimetic capacity. While there is undoubtedly some truth in this, the issue is not so simple.

When we speak of the mind, we usually invoke a theoretical entity called the "cognitive process," which can be broken down into various component functions, such as perception, working memory, spatial attention, lexical search, episodic recall, and so on. Any complex mental task, including the production and viewing of art, is made up of chains of these simpler components, arranged in operational hierarchies that resemble the algorithms of computation. These simple component operations are innate, and thus the "cognitive architecture" of virtually any complex task can be translated into an arrangement of basic component operations. This might be termed the "cognitive" deconstruction of the artistic process.

It follows that the act of looking at a painting might be deconstructed into a series of very brief components, each of which produces a "glimpse" of the object. These components include such things as moving the eyes, fixating and focusing them, processing the fixated image, storing that image in some form of temporary, or buffer, memory, and synthesizing the whole series of remembered images into a unified perception of the painting. This percept might then be subjected to further scrutiny in memory. This sequence might be repeated and reflected upon many times, before the viewer acquires any "expertise" or familiarity with the painting.

It is evident that this type of complex cognitive sequence, which is typical of everyday cognition as well as of the experiencing of art, involves a very complex series of brain operations. Some of the neural activity that drives these operations (to date, only the most elementary ones) can be observed by electrical recording and brain imaging. Predictably, most works of art activate many brain regions, and engage a variety of

intellectual and neural resources, depending on the modality of the artistic medium, and the type of representation offered. Every creative or interpretative act, regardless of its input modality or conceptual demands, can be broken down, or deconstructed, in this way, into its neuro-cognitive "atoms."

In every case, these translate into a series of elementary brain operations that unfold in a complex sequence. The sequences will be quite different for various kinds of cognition, and for dissimilar artistic media, but the components will be basically alike. These complex sequences can become habitual and automatic. Thus, my reaction to one of my favorite paintings, Gustav Klimt's *Hope I* (National Gallery of Canada, Ottawa) always follows a predictable course, and has become quite automatic. My gaze always starts in one of a few possible places, and moves around the painting in a fairly predictable order, with emphasis on certain key features. These features lead me to a certain state of mind, and elicit memories which govern how I see the painting. This is a well-studied aspect of visual perception, and involves little or nothing by way of operations that are unique to the artistic experience.

The uniqueness of the artistic experience produced by that painting in my brain can undoubtedly be traced back, if not to the elementary components in the sequence, which are commonplace mental operations found in a variety of visual experiences, to the high-level neural consequences of the actual sequence of meanings and associations uniquely triggered by this painting. Such sequences of meaning, which I have referred to as "Condillac sequences" (Donald 2001), lead to, and sustain, the cognitive end-point of the artistic experience: a unified state of awareness that such a work of art should ideally set up in my, or any viewer's mind. Unfortunately, neither brain imaging technology nor neurobiology has solved the problem of how to measure, let alone model, these abstract

chains of meanings, or the specific states of awareness they induce. The technology to do this may come in the future, but it is not yet available.

However, the real limitation of this approach is not our lack of knowledge about the physical basis of Condillac sequences, or states of consciousness. A more serious limitation lies in the fact that the common component processes of experience in the nervous system are not the only drivers behind the experience of art. It may be argued that the most important drivers are largely cultural, or cognitive-cultural, and depend not only on what is experienced, but also on interpretative algorithms that may be peculiar to individuals or societies, and have no fixed neural instantiation. Despite careful crafting by the artist, a work of art itself can never be entirely in control of the end-state it produces in the recipient. It is the sequencing of artistic experiences in time, and the way these are juxtaposed in memory, that lead the viewer to a specific end-state.

We might like to say that the main driver of artistic experience is the artist, and this holds partly true. Certainly, the way the artist manipulates events so as to set up an end-state in the minds of the audience starts the process running, and some techniques (such as those of film) can be extremely compelling in controlling the audience's experience. But the brain might deconstruct the world presented by the artist in many different ways, and through many different paths. The major underlying cognitive challenge is not to discover all these paths; this is impossible, and pointless. Such an endeavor would not be unlike a particle physicist's wasting his time trying to track every electron in, say, a room full of people at a cocktail party. Why would one want to do this? It would explain nothing about the work of art, or about cognition. It is the very source of art-based cognition we should be chasing here, not the specifics of any particular work of art. Therefore the

relevant research question is: What is the question? What principle should we be testing with empirical brain research?

To a cognitive scientist, art represents a singular, rather peculiar way of knowing the world. Art attacks the mind, not usually through its logical or analytic channels, but more commonly through its senses, passions, and anxieties. Under the distant guidance of the artist, the brains of the viewers gather the disparate pieces of evidence placed before them, while they draw on their own experiences to reconstruct the intent of the artist. The challenge for the scientist is to interpret the cognitive source of the world-view intended in the work. This can rarely be reduced to the solving of a simple static stimulus, or to any moment frozen in time. It almost always entails the integration of many complex perceptions over many viewings. Such interpretations are inherently dynamic in nature, and mostly, they engage large-scale neural integration over time.

Inevitably, when a person views a work of visual art, the piece is initially deconstructed by that person's brain into a series of glimpses, scanned into various short-term memory stores. This occurs according to the dictates of the nervous system, and the cognitive process. There is no way to avoid those dictates, since the mind cannot be separated from its neural underpinnings. This process provides the higher interpretative centers of the brain with multiple frames, spread out over time, much like a cinematic sequence. This is true even if the object is a static thing, such as a sculpture, because such objects are always viewed in several glimpses taken over time, from various distinct fixations, from different angles and distances.

The resulting pattern of activation of the visual brain, as observed in brain imaging or electrical recording, involves the sequential activation of hundreds of millions of neurons in many places in the nervous system. This activation pattern is mostly regional,

and each region is specialized for a particular class of cognitive operation. Thus, the neurons in one region of the visual brain might respond only to subtleties of color, while in another region they would respond to induced movement, or form, or depth. Or touch, or sound. The brain has many different regions that decipher a variety of distinguishable aspects of the world, and if any of these is malfunctioning, we do not register that aspect accurately.

The work of art is somehow reconstructed from these seemingly disconnected bits and pieces of experience. This is done by an unknown integrative process, in what we euphemistically call the "higher regions" of the mind, where the work is ultimately interpreted. In terms of the laws of higher neural processing, we have no idea how this final step is achieved. We know much about the neural principles underlying such processing, and we know roughly which geographic regions are most involved, but we still have no adequate theory of how these large-scale parallel neural networks can create such an abstract and detailed conceptualization of the world.

We do know, however, that many species must have the same elements of sensory and perceptual intelligence as we do, despite having produced nothing like what human beings call art. The basic processes of the nervous system are very similar in monkeys, apes, and humans, and the overall design of the brain is virtually identical. The human brain is much larger than those of apes and monkeys in certain areas but, as far as we have been able to determine, it has no qualitatively new regions or features. This might tempt us to think that the primate brain is a good starting point for a cognitive theory of art, and there is probably some gold to be mined by such studies. However, this is a self-limiting strategy, and cannot explain much about the interpretation of art, since it avoids the central question: What makes humans so different?

The answer seems to lie elsewhere, not in the brain by itself. In the case of human beings, there is an additional factor that must be taken into account in explaining art: a collective cognitive process known as culture. Culture is a very significant factor in human cognition, because human culture is uniquely cognitive in its function. Human culture is a marketplace of ideas and images, feelings and impressions. Indeed, it is a vast cognitive network in its own right. The cultural network introduces an entirely new element to human life, immersion in a cognitive collectivity, or community of mind. This is perhaps the primary source of the enormous cognitive differences between human beings, and our closest genetic relatives. Monkeys and apes solve the world alone; we do not. Human culture is based on the sharing of mental representations, and we are tethered to that network. It allows us to achieve things that are far beyond the capabilities of an ape, or, for that matter, a socially-isolated human brain.

Artists may sometimes have the illusion of separateness, and isolation from society. But in reality, they have always been society's early warning devices. The best of them are connected, and more deeply enculturated than most. It follows that the sources of their creativity, although partly personal, are also public, outside the nervous system, in the distributed system itself; that is, in culture, which encompasses, but supersedes, the individual nervous system.

The evolutionary origins of art

Art is an inevitable byproduct of the first truly human cognitive adaptation in hominid prehistory. It is the signature feature of the human mind, mimesis, and its public consequence, mimetic culture (Donald 1991).

Mimesis is an analogue or holistic style of thought that is more basic to our way of thinking than language or logic. Indeed, language and logic evolved much later, from a

mimetic platform. Mimesis is a foundation-skill that arrived early in evolution, and defined the human style. The components of mimetic cognition are present to some degree in primates, but are vastly more developed in humans. This makes mimetic culture a logical, but radical, extension of the primate mind. It remains an important force in human affairs, and produces such typically human cognitive patterns as ritual, skill, gesture, tribal identification, personal style, and public spectacle. It explains our irresistible tendency to imitate one another and conform to patterns of group behavior, especially group emotional expression. It sets the tone of human social life, and it is the ultimate driving force behind art, which might be viewed as the ultimate refinement of the mimetic mode.

Mimesis is an innate capacity, and its universality allows human society to function smoothly. But this may also be a source of concern, since our mimetic tendency to conform is a potentially fatal flaw that might someday destroy the human race; but that is quite another question. Certainly, without mimesis, human society would be very different. If humanity had somehow managed to evolve language and symbolic thought without first having had to establish the evolutionary platform for it in mimetic cognition, we would have very different minds. And very different cultures.

What is mimesis? The easiest answer to this question is simply to list some of the behaviors it encompasses. The term mimesis describes a cluster of capacities that were made possible by a single neuro-cognitive adaptation. They go together historically, because they share certain key neural components. The four central mimetic abilities are mime, imitation, gesture, and the rehearsal of skill. Human beings are uniquely good at these. Apes have some small degree of competence in these areas, and this strengthens the case that these capacities might have been subjected to selection pressure early in

hominid evolution, primarily to improve our ancestors' ability to obtain a high-quality diet in a changing environment.

Mimesis seems to have evolved as a cognitive elaboration of embodiment in patterns of action. Its origins lie in a redistribution of frontal-cortical influence during the early stages of the evolution of species *Homo*, when the prefrontal and parts of the premotor cortex expanded enormously, in relative size and connectivity. The cognitive significance of this lies in the fact that, in virtually all social mammals, the frontal regions are concerned with the control of action and behavior, as opposed to the posterior areas, which are broadly concerned with the elaboration of perception. The disproportionate expansion of frontal influence gave hominids greatly improved motor control. More importantly, the expansion of the prefrontal cortex was crucial in improving conscious self-regulation and metacognition. This created a new metacognitive field, a greatly expanded and differentiated working memory, in which hominids could observe themselves as actors, and rehearse and refine whatever they were doing. This also gave them some ability to reflect on the cognitive process itself, and the option of deliberately reflecting on, and shaping, their own actions.

The latter point is worth some elaboration. Only human beings reflect on their own actions, and modify them accordingly. Human children pass large amounts of time in skill-related play; that is, in rehearsing and altering their own actions. For instance, they might spend an entire afternoon improving their ability to bounce a ball, skip stones, make faces, assume odd postures or create novel sounds. No other creature does anything like this. Many species engage in play, of course, and innate skills need to be exercised frequently in developing organisms. But most species play in a stereotyped manner, and do not generate truly novel patterns, or engage in role-playing or imaginary games. It is

as if their attention was fixed on the external world, and unable to redirect itself toward the internal world of action. That is a great limitation, because it precludes what humans know as culture. If attention is exclusively outward-directed, then motor activity, generated internally, remains fixed and stereotyped. And this rings true when examining what virtually all other mammals can do. They appear much less self-conscious than humans. Their awareness is other-directed, not self-directed.

Mimesis is the direct result of consciously examining our own embodiment, of the brain using its body as a reduplicative device. The cognitive engine of this expressive skill is a much more powerful working memory space, and an inner theater where imaginary actors play with actions and expressions, in which the embodied self plays out various possible roles in the social world. It is also a place where self-initiated actions can be judged, altered, and exposed to internal critical scrutiny. The outcome of this remarkable process is a characteristically human capacity for re-enacting events in a nonverbal, gestural, fuzzy, quasi-symbolic manner. A child's simple pantomime of a tea party or bedtime is a good example. It is an imaginary *playback* that tries to reduplicate an aspect of perceived reality, but alters reality in the process. *Reality* does not in fact look anything like its putative re-enactment, and every successive mimetic act in such a sequence will become another variation on the initial re-enactment. The metacognitive part of the mimetic mind can reflect on this scenario, which can be altered until the child judges it to be *right*. Unlike the stereotyped play of animals, the details of such a performance are never fixed. Mimetic expressions, even the simplest of them, are inherently creative and somewhat arbitrary. Mimesis can produce a virtual infinity of specific forms, even in the simplest reenactment, charade or pantomime.

Moreover, mimetic expressions can potentially engage any part of the body. They are not limited to one sense modality, like the songs of birds. Rather, the mimesis is truly amodal, and can map virtually any kind of event-percept onto virtually any set of muscles, using many different specific readouts. This leads to flexible analogue motor expressions, or action-metaphors. I might normally indicate anger with my face and low-level voice modulations, but at a distance I can substitute larger body-gestures and very different sounds to achieve the same communicative effect. In a board room I might limit my expression of the same emotion to polite finger-tapping or searing glances. The point is that a mimetic production is never limited to one set of muscles, or one fixed set of expressive forms. Mimetic creativity is *domain-general* or supra-modal, and fully accessible to consciousness. It meets all the criteria for what Fodor called a *nonmodular* adaptation (Fodor 1983) because it can range across all the perceptual and motor domains given to the actor's awareness. It creates a very abstract mimetic *mapping* of an act-model onto a perceptual model, and this capacity allows the actor to use any part of the body to formulate and transmit intentions, ideas, and skills.

At the same time, mimesis is the supporting adaptation of many other human endeavors. It enables athletes, skilled craftsmen, and other performers to refine their skills by generating variations on their actions and selecting the most successful ones. Mimesis is always an attempt to reduplicate some aspect of reality in action, and in the case of skilled rehearsal, the rehearsal itself is a mimetic act; the performer is imitating his or her own previous actions, and creating variations of those actions. The result is a personal repertoire that can be altered toward achieving some ideal of action. This is the cognitive path to a multitude of human skills. People acquire an incredible number of skills in a

lifetime—they play sports and music, drive, and talk, to mention a few—and all these skills have been learned and improved through mimetic action.

Mimesis is the original source of human culture; that is, communities of mind linked together in a public expressive domain. Taken together in a small group, the mimetic actions of a group of primate actors will inevitably generate a social theater of some complexity, and a microscopic version of human culture, limited in its range of expression. On a larger scale, the same abilities will establish the implicit customs and folkways of a truly human culture. Even in the absence of language this process carries out its work, as happens in communities of nonsigning deaf people. Mimetic role-playing and fantasy constitute a basis for a limited world view, but one that is at least partially public, and subject to some degree of cultural change. When this capacity was amplified through an interaction with spoken language, the expressive potential of mimesis was fully realized, resulting in an expressive culture of great power.

Where did mimesis come from? Our closest relatives are the chimpanzees, with whom we shared a common ancestor five or six million years ago, and whose genes are very close to ours. But while chimps and humans have virtually similar cognitive capacities, they are very different from humans. We have traveled an inordinate distance, and this needs an explanation. It is true that our brains have tripled in volume, doubling their number of neurons, and that certain brain areas have expanded disproportionately. But there do not seem to be any new neural modules or neurochemical transmitters in the human brain. The most radically novel factor in our evolution is culture itself, as a collective storehouse of knowledge, and our brains have evolved specifically for living in culture. We are the species that made cultures into distributed cognitive systems, and

those systems have re-shaped our brains. In fact, the human brain cannot realize one of its key design potentials, symbolic cognition, without extensive cultural programming.

If we concede that human infants get language and all the tools of symbolic thought from culture, then we should ask: Where did cultures come from? What generated them *de novo* in the wild? The answer is: mimetic action. Apes are notoriously poor at mimetic action. A species cannot generate a culture until it can escape the autochthonous solipsism of the central nervous system, and generate a common cultural space that can accumulate knowledge. Apes never managed to do this, primarily because they are so poor at gesture and imitation, and virtually incapable of deliberately self-supervising the rehearsal of their own actions to refine them. However, they have some of the key elements of mimetic ability, and this gave natural selection the opportunity, once conditions gave fitness value to improved mimetic skill, to nudge and shape archaic hominids in the direction they eventually took.

The importance of mimesis can be seen in the limitations of even the most brilliant enculturated apes, who can manage symbol-use much more easily than the gestural or skill-related dimensions of human culture. It may seem odd that Kanzi (the star performer of enculturated chimpanzees, who can segment the speech stream, understand some of the rudiments of grammar, and employ a vocabulary of several hundred symbols) cannot manage even a simple iconic gesture, or engage in the kind of role-playing common in two-year old children. Nor can he play basketball, as his trainer observed. But this is not odd at all; it is entirely consistent with what I have said about the crucial importance of mimesis in human cognition.

Summary and conclusion

In summary, art is a distinctively human form of cognitive activity that is characterized by the following features. (1) Art is aimed at influencing the minds of an audience, and as such, it might be called a form of cognitive engineering. (2) It always occurs in the context of distributed cognition, and is (3) constructivist in nature, aimed at the deliberate refinement and elaboration of world-views. (4) Most art is metacognitive in its role, that is, it engages in self-reflection, both individually or socially. (5) The forms and media of art are technology-driven. (6) The role of the artist, and the local social definition of art, are not necessarily fixed, and are a product of the current social-cognitive network. (7) Nevertheless, art, unlike most conventional engineering, is always aimed at a cognitive outcome.

Viewed in an evolutionary context, art originated in the earliest stages of hominid evolution, the so-called "mimetic" phase. Newer forms were scaffolded on the older ones, and, as human beings evolved complex languages and technologies, artists developed a number of new forms that contain within them elements of our evolutionary history. Every newly-evolved artistic domain has a unique combination of these elementary components. Surveyed as a whole, the domains of art ultimately reflect the entire evolved structure of the human cognitive-cultural system. The challenge to cognitive and neuroscientists is to develop a methodology that will allow them to fathom the abstract amodal processes of large-scale neural integration that transform the complex Condillac sequences imposed by artists on their audiences into meaningful experiences. Finally, the ultimate engine of art, and the common force that makes art so distinct from science, is mimesis. Therefore the genesis of art will not be understood, even in principle, until the neural and cognitive principles and mechanisms of mimesis are better understood.

References: Donald

(In the final manuscript, the references will be combined into one section at the end of the book.)

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Chapter by Francis Steen: A Cognitive Account of Aesthetics

Headnote: The study of aesthetics within an evolutionary framework has focused on the appetite for beauty as an engine for driving adaptive behavior in habitat and mate choice. In this chapter, I propose instead that aesthetic experience is its own goal, in the sense that the experience implicitly provides adaptively useful information utilized for purposes of self-construction.

Introduction

At the cognitive roots of art is a subjective phenomenology of aesthetic enjoyment. Private and intimate, or ostentatiously public, such feelings constitute on the one hand a centrally gratifying dimension of being alive, and on the other a mystery, a gift without a card. To the project of reimagining and reconstructing the full depth of human history, of situating our current cognitive proclivities and capabilities within a renewed narrative of human origins, the phenomenon of aesthetics presents a crucial and delicate challenge. Current work in evolutionary theory is animated by the seductive promise of a functional explanation for every key human trait. Yet the variety and complexity of the aesthetic impulse, along with its myriad expressions, may make us conclude, very sensibly, that reality simply overflows our theories.

Nevertheless, I submit wholeheartedly to this seduction, with the caveat that a functional analysis of aesthetic enjoyment must be shifted into a new dimension. The field of evolutionary aesthetics (for an overview, see Voland and Grammar 2003) has principally focused on landscape preferences as a function of adaptations for habitat choice and the experience of human beauty as part of mate selection. While these

perspectives are not unsupported by credible evidence, they leave out vast tracts of aesthetic experience – from neolithic symbolic art to what Robert Hughes (1991) called "the shock of the new," from the frivolous to the sublime. What evolutionary aesthetics has so far failed to provide is a credible framework for understanding the surprising range of aesthetics. Just as significantly, the implicit underlying assumption that aesthetic pleasure is comparable to the pleasures of sex and food in driving adaptive behavior (Orians and Heerwagen 1992: 555) is clearly false: the subjective phenomenology of aesthetic enjoyment differs qualitatively from desire. In contrast to hunger and lust, the experience of beauty is prototypically its own reward; unlike these, it does not find its release, fulfilment, and satiation in possession. To the extent that this is so, we must look for an explanation that honors beauty itself as a resource, without seeing it as a proxy for something else.

In the following, I argue that the aesthetic impulse and experience is an appetite for certain types of information – in a word, that beauty is a kind of truth. I take my cue from John Keats' "Ode on a Grecian Urn," which famously and rather fatuously proclaims that beauty is the only kind of truth we have or need. My claim is both more modest and in some ways more far-reaching: while beauty is certainly not the only kind of truth we need, we appear to use it for a most intimate and crucial task, that of constructing ourselves. Not to skimp on the complex subjective phenomenology involved in this process, let us turn for a moment to the poet's animated description before I elaborate.

In "Ode on a Grecian Urn," the speaker addresses the artifact as a "sylvan historian," praising its skillful telling of a "flowery tale." Although urns, as everyone knows, don't talk—Keats obliquely acknowledges this by calling it "foster-child of Silence"—the object can be used to convey a story through images. The scenes depicted

on its exterior are understood as snapshots of a fictive or historical narrative, the details of which the onlooker may attempt to infer: "What mad pursuit? What struggle to escape?" In this narrative, the characters portrayed have both a past and a future. To understand the scenes as adding up to a story, the onlooker must see them as iconic representations of entities whose existence is independent of the urn itself, illustrations of events to be filled in by memory and imagination. In Korzybski's words (1933), they are no more to be confused with the events themselves than a map with the territory.

In the second stanza, the poet immerses himself imaginatively into the depicted scenes, pretending that the bas-relief marble figures are in fact real human beings in a state of permanently suspended animation, yet with a fully intact consciousness, including perceptions, emotions, and intentions. In a surprising attempt to console them, he informs them about the peculiar nature of their situation, of which he assumes they are unaware:

Bold Lover, never, never canst thou kiss,
Though winning near the goal—yet, do not grieve;
She cannot fade, though thou hast not thy bliss,
For ever wilt thou love, and she be fair! (Keats 1820)

In this perspective, the world imaginatively reconstructed on the basis of the artwork on the urn exists only on the urn itself. No longer depictions of independently existing events, the scenes are now perceived as mini-worlds of their own, subjectively as real for its inhabitants as ours is for us. Keats highlights what he sees as the salient feature that distinguishes it from our world: it is uniquely characterized by the absence of time. So implausible is this conceit that no attempt is made to explain how a whole community and their natural environment ended up in a waking and blissful but otherwise cryogenic state in the permanent exhibition of the British Museum. Somehow, and we are not

invited to contemplate how, the people in the story have become trapped by their representation, life has transformed into art.

In the third stanza, the poet argues that this artistic and imagined world is preferable to our own. In the real world, "breathing human passion" leaves people in pain, either through deprivation or surfeit; in contrast, in the world on the urn, there is "More happy love! more happy, happy love!" By removing time, art achieves an uninterrupted and unvarying delight. It may be countered that art objects are just as subject to change over time as are other objects, people, and events, and that it is only in the imagination that the depicted worlds are frozen in time. In his description of the urn, the poet is blurring the vital distinction between what is constructed as it were out of whole cloth on the basis of memories, supplemented by some curiously shaped marble, and what originates in a genuine perception of reality.

If the poet is committing a categorical [CATEGORY?] mistake, however, he does so knowingly and on purpose. In order to construct and contemplate the rich possibilities of an artistic, fictive world, it appears to be necessary to dedicate our working memory capacities to this task, unburdened by the challenges of reality. Retracing his steps, Keats unwinds the fancy, performs a controlled retreat from the depicted world and resumes his address to the urn itself in the last stanza. He praises it for its capacity to "tease us out of thought"—the implication being that beauty is strongly experienced as its own reward and that the mind is inherently attracted to it, to the point that it will temporarily set aside its own engagement with reality in favor of the aesthetic and imaginatively enhanced worlds of art. Finally, handing the microphone to the urn, the poet imagines that the urn itself formulates its enduring meaning and significance to future generations:

Beauty is truth, truth beauty,—that is all

Ye know on earth and all ye need to know. (Keats 1820)

The claim is clearly exorbitant, even if we make allowances for the speaker's being an urn. Coming on the heels of a sequence of imaginative projections and self-evident counterfactuals, the artistic object's claim to referential truth is weak. If beauty is truth, what kind of truth is it? In the following, I provide a strong if partial defense, situating the poet's intuition of the importance of aesthetics within a cognitive and evolutionary framework.

Natural aesthetics: an appetite for beauty

In order to accomplish the complex task of constructing a functioning brain, the information contained in the genes does not suffice. While important target values appear to be genetically specified, the paths taken to reach them are not (Turner 1996:25). For this, the organism depends on information that is reliably present in the environment. We can think of the genes as a series of switches activated by an orderly progression of environmental conditions, starting with the sheltering and nurturing enclosure of the womb. The power of the genome to determine the development of the organism is wholly subject to the structure of the environment in which it finds itself. Natural selection operates on functional outcomes; these are joint products of the complex order of the environment and some additional genetic information. If the environment reliably contains the information required to construct the brain, natural selection can be expected to favor mechanisms that effectively access this information.

In many cases, the information required is ubiquitous. A famous series of experiments showed that cats raised in an environment without vertical lines failed to

develop the capacity to perceive them (Stryker et al. 1978, Tieman and Hirsch 1982). In the long course of mammalian evolutionary history, there was never an environment that lacked vertical lines. During critical periods of development, infant cats from snow leopards to jungle jaguars have been able to tacitly count on the recurring presence of vertical lines around them. Over tens of millions of years, the inability of feline genes to provide the information necessary to build a brain that perceives vertical lines in the temporary absence of such lines has had no functional consequences, and has therefore not been subject to deselection. Since the necessary information was an inherent and ubiquitous part of the structure of their environment, a relatively passive mechanism for accessing it would have sufficed.

In other cases, the information may be unevenly distributed and vary in quality. Here natural selection can be predicted to favor mechanisms that detect relevant quality differences and exhibit an active preference for features of the environment that present high-quality information. The information will in effect constitute a scarce resource to be monitored and sought out. When found, it can be absorbed and utilized by the brain to pattern a targeted function. The active case is what concerns us here, as this is where I propose to ground aesthetics.

Consider the recurring necessity of calibrating the embodied brain's perceptual systems. These are highly complex and sophisticated mechanisms, implemented in organic systems under constant change and upheaval. Some of the work of the senses is dull and monotonous. Under these conditions, the system may rely on certain features of the environment for recalibrating itself. It may be important, for instance, to obtain reliable information about baseline values as well as a rich sense of the full range of sensory phenomena the system is designed to handle. As long as all this information is reliably

present in the natural environment, even if it is scattered in time and space, natural selection can be predicted not to favor potentially expensive mutations that engineer it into the genome. In this sense, it is more like food than gravity or vertical lines: reliably present, but requiring an active search, discriminating capacities, and a set of preferences expressed as appetite.

It is in this territory, then, that I propose to locate the phenomenon of aesthetics. In general terms, the suggestion is that our attraction to beautiful objects and events, and our experience of aesthetic enjoyment, may coherently be understood as the results of a biological need to locate certain types of information in our environments, as a supplement to genetic information, for the purpose of constructing and maintaining our own order. More narrowly, the prototypical function of aesthetics is to bring our senses back to life, or to an optimal state. In this sense, it constitutes an ancient evolutionary solution to the problem of calibrating various components of our multidimensional sensory systems. Natural selection, according to this model, has produced a set of adaptations designed to search the environment for certain types of information, and to engage in activities that will make this information salient. We can be predicted to show an active preference for a class of features of the environment, namely those that in evolutionary history our ancestors were able to rely on to supply information complementing that supplied by the genome. The aesthetic impulse would be an appetite for information that in our distant past was recruited and relied on for optimal self-construction, regulated by a developmental chronology.

I'm not suggesting we know we're doing this. If aesthetics is an evolved mechanism for constructing and maintaining complex patterns of order in the brain, it does not advertise itself as such. We do not seek out aesthetic experiences as the result of a

conscious and deliberate intention to reach a specific goal; in fact, the distal cause of aesthetics is cognitively impenetrable. In order to gather the necessary structuring information, the conscious mind does not need a conceptual model of the distal purpose and function of aesthetics, nor does it need access to the complex internal logical of the operation of this function, any more than it needs access to the intricate nanotechnology of digestion. The biological function of aesthetics is complex in principle and execution, and there is nothing to be gained and much to be lost by clogging up the limited bandwidth and processing capacities of the conscious mind. What is made available to consciousness is a phenomenology of aesthetics that is experienced as an end in itself and inherently motivating, an experience that is rich and delightful, confirming the exquisite order of the world and indeed our place within it. Inversely, under conditions when our senses for long periods are deprived of an aesthetic order, we experience a palpable dissatisfaction with the quality of our sensory environment, a nagging and aversive sense of boredom, and a longing for change.

Is this a credible theory of aesthetics? I should note here that my aim here is not to construct an all-encompassing theory; as Prigogine and Stengers (1984: 1) note, reality always overflows our descriptions of it. Aesthetics is a delicate and subtle cognitive event, and these qualities, I suggest, reflect back on the complex and fluid organic order that forms and sustains a human being. The social and cultural uses of aesthetics presuppose rather than negate a biologically grounded explanation. If it had not existed, surely the phenomenon would have been unimaginable: all culture can do is tap into the capacity, in endless variations. While aesthetic preferences themselves vary, for reasons I explore below, the presence of art in all documented cultures, past and present, indicates that the phenomenon itself is universal (cf. Brown 1991). The purpose of an adaptationist

account of aesthetics, then, is not to reduce a complex phenomenon to a simple one, but to gain a genuine insight into its complexity.

This is a trivializing view of aesthetics only if we view the order of the universe as trivial. Primary aesthetic events and objects include the vast silence of the stars at night, the brilliant play of colors in the clouds at sunset, tumbling and crashing waters, the complex fluid dynamics of a rushing river, birds' song, the delicate shape and coloring of flowers and leaves, a bare tree, the shape and movement of a healthy animal. Our evolved aesthetics has to be a natural aesthetics, responding to an order that is reliably present rather than to one that is manufactured. Prototypically beautiful natural events are characterized by a dynamic and ordered complexity, or by evidence of what we might term a generative order (Bohm and Peat 1984). By this I mean that we experience the complexity of beauty as a complexity that emerges in an orderly manner through the operation of an underlying generative process; for instance, a waterfall is continuously generated by gravity acting on water in motion, the slowly changing pink hue of the clouds at sunset is generated by the gradually changing refraction of the light from the setting sun, and the delicate leaf is produced by a patterned order of growth. The aesthetic response appears to pick out these dynamic processes and the intrinsic delight of aesthetics appears to stem from an appreciation of the inferred but invisible underlying order that generates the manifest phenomenon. The present proposal is that we unconsciously make use of such complex natural orders in wiring the brain and calibrating our perceptual systems, that our self-construction relies on them, and that natural selection has constructed a motivational system that leads us to seek them out.

As long as it is embedded in nature, a society might not feel the need to celebrate the beauty of its environment explicitly. In the West, it was the large-scale

industrialization and urbanization of the eighteenth and nineteenth centuries that spurred an interest in the importance of natural aesthetics. The poet William Wordsworth became a primary spokesman in England for this growing cultural movement. In "Lines written a few miles above Tintern Abbey, on revisiting the banks of the Wye during a tour. July 13, 1798," looking back on his childhood, he contemplates the impact the sheer sensory experience of nature had on his formation as an individual. He emphasizes that he experienced a wide range of natural forms as enjoyable and meaningful in themselves, a passion and an appetite that did not rely on any conscious purpose or perceived utility. "For nature then," he writes,

To me was all in all. – I cannot paint
What then I was. The sounding cataract
Haunted me like a passion: the tall rock,
The mountain, and the deep and gloomy wood,
Their colours and their forms, were then to me
An appetite; a feeling and a love,
That had no need of a remoter charm,
By thought supplied, nor any interest
Unborrowed from the eye. (Wordsworth 1798: 76-84)

In "Tintern Abbey," Wordsworth provides a particularly rich account of the phenomenology of the experience of natural aesthetics. He describes the mental state involved as distinct and characteristic, as deepening and intensifying through a sequence of stages orchestrated by emotions, and culminating in a suspension of the body similar to sleep, in which the mind perceives a profound truth:

—that serene and blessed mood,
In which the affections gently lead us on,—
Until, the breath of this corporeal frame
And even the motion of our human blood
Almost suspended, we are laid asleep
In body, and become a living soul:
While with an eye made quiet by the power
Of harmony, and the deep power of joy,
We see into the life of things. (Wordsworth 1798: 41-49)

Truth, in this case, is "the life of things": a hidden and generative order that is the target of the aesthetic faculty and that delivers a climactic and perfect satisfaction to the appetite for beauty.

Imagination and the virtual agent

By focusing on the dynamics of natural aesthetics, I have attempted to sketch a model of how our appetite for beauty may have a basis in biology, as aspects of an adaptation that dates back millions of years. This model, however, does little to account for the truth claims made for art, understood as the objects and events that we design and manufacture for their aesthetic effects. Natural forms and events actually take place, and an insight into their underlying generative order, if accurate, carries a credible claim to an interesting kind of truth. Yet the cognitive processes that animate Keats' "Ode on a Grecian urn" appear to be qualitatively different from Wordsworth's sensory rhapsody, dealing as they do with imaginary situations that we have no reason to believe are in any exact sense historical, and centrally involving the wholly implausible claim of a

transformation of inanimate depictions into conscious agents. Who needs a notion of falsehood if this is truth?

To get a handle on what is going on here, let us consider some simpler examples of the same phenomenon. The elementary guiding principle of artistic creation is to trigger a controlled series of sensations that awaken an aesthetic response. This definition is less vacuous and circular than it might seem: the detailed characteristics of our aesthetic response system are unknown to us, and in the making of art, it can be systematically probed. At the same time, the proposed adaptive design of the aesthetic response engine is to detect and acquire information in the environment that is not present in the genes or in its own structure, for the purpose of wiring the brain. This means that through art, an individual can not only acquire a certain type of self-knowledge about his own aesthetic preferences, but also use the art itself to propose new orders. These new orders can then be selectively incorporated into his own perceptual system, in effect teaching him to perceive and sense the world in new ways.

As long as these orders tap into the adaptive design of our aesthetic system, they need not replicate natural aesthetics. Adaptive design is by necessity a product of particular if usually prolonged historical circumstances, and gets constructed within the context of a certain environment because it solves a present problem. Any adaptation will have a built-in slack—areas where it may function in interesting and potentially useful ways even though it was not designed to do so (for a discussion, see e.g., Sperber 1996). By proposing new perceptual orders, artists tap into both the core and the unused fringe capacities of the aesthetic response system to explore complex sensory orders that have no precedent in nature.

Experiments have shown that, when provided with the means, non-human animals are capable of formulating and carrying out the intention of creating aesthetic objects. The lowland gorilla Koko, whose work featured prominently in a primate art show at the Terrain Gallery in San Francisco in December and January 1997-8, uses broad strokes of primary colors to achieve a remarkably lively and complex aesthetic effect.



Figure 1. A painting by Koko

I'm speaking for myself here, and leave open the possibility that much of the distinctive effect is due to the human scaffolding: the laying out of the canvas and the paint, the focused encouragement, the choice of the moment of completion, and of course the selection of canvases to exhibit. Moreover, I find it intriguing to contemplate the

difference it makes for my appreciation of the painting to consider the mind of the creator. Are these lines clumsy strokes that arbitrarily criss-cross and fortuitously suggest a complex order, or are they the intended results of a delicately sensitive mind, sharply aware of the subtle play of form and color? In the former case, it would be misleading to call this art—or to put it differently, the artistic act should be attributed to their human friends and handlers rather than to the gorillas themselves. A distinctive feature of art as communication is that at some link in the chain must be the act of declaring something to be an aesthetic artifact. Treating Koko's paintings as art carries with it the necessary implication that gorillas have a sense of aesthetics.

In fact the anecdotal evidence strongly suggests that our closest simian relatives have an independent and self-motivated urge to create art, and that this enjoyment drives and orders their activities towards end results that humans have no difficulties relating to as art, even high-quality art. Desmond Morris (1962) reported in the early 1960s that chimpanzees would get so absorbed by their painting that they forewent food, evidently finding the activity inherently enjoyable. When systematically given a reward for each painting, however, their work would degenerate to a minimal smear to obtain the reward. This suggests that the animals have aesthetic response systems very similar to ours, that they experience aesthetic pleasure, and that, just like us, they are capable of targeting this aesthetic pleasure through their own exploratory and original creations in ways that are unprecedented in their natural history.

Koko's work is not obviously figurative, but the paintings are given titles that suggest a subject (the one above is titled "Bird"), based on signs exchanged with humans at the time of painting. Representational art relies on a complex suite of cognitive adaptations, some of which are clearly present in apes. (For a discussion, see Steen in

preparation.) The gradual development of the capacities required to make sense of images can also be observed in infants.

I sometimes read picture books with a friend; younger than two years, she likes to point at various items she is familiar with and name them. The items, of course, are depictions and not the objects themselves; they are two-dimensional, stylized, small, and feature-poor versions of the actual things she names. In order to utilize the affordances of the depiction of hats and balls and to interpret the drawing as iconic, rather than as a colored blot on a piece of paper, she must activate her personal memories of these objects, memories that are laced with emotions and motor activity. "Ball!", she exclaims with passion, likely the same passion she feels for the real object. In her mind, there is a simulation of a ball, or more conservatively a simulated response to a ball, and it is this simulation that constitutes the act of understanding the image. This act of making sense of an iconic depiction is very similar to the act of pretense: it involves the reinterpretation of perceptual input based on a counterfactual scenario, one in which there is a hat (for a more detailed treatment, see Steen and Owens, 2001).

It may appear excessive to invoke the notion a simulation to explain something as elementary as understanding a picture. After all, pictures of hats and balls look like hats and balls; why should it be any harder to understand one than the other? The point here is that since images are not what they represent, it is not adequate to respond to them as if they were. Understanding a picture is not a matter of making a mistake, of momentarily confusing pictures of hats with hats, and then realizing that you missed the mark. At the same time, understanding a picture of a hat involves precisely something very like this type of confusion: it requires activating the response system that handles real hats. Only by activating the appropriate target response system will the picture of a hat make sense to

you as a hat. In less paradoxical terms, understanding the picture of a hat requires that your brain respond to it as if it were a hat, but that it simultaneously track the fact that it is just a picture. In this sense, the picture prompts a simulated response: a response that duplicates key features of the real experience, but lacks its real consequences.

In this view, the act of responding to an image is an act of pretense. It requires that you set up a distinct mental space in consciousness to handle the perceptual input of the image as well as the output of the target response system. While the cognitive machinery of pretense can be utilized for executive purposes such as symbolic communication and planning, it seems likely that the capacity to pretend first evolved to enable behavioral simulations such as chase play and play fighting – that is to say, to solve problems related to self-construction (Steen and Owens 2001). As such, pretense represents one of the central cognitive innovations of the organizational mode. It is designed to solve a particularly complex adaptive problem, that of improving performance on a task in the absence of the normal eliciting conditions. Pretense allows the young mammal or child to make use of affordances in its environment to devise learning situations that are safe, readily available, and developmentally appropriate. This amounts to saying that natural selection acts on the organizational mode to elaborate what might be termed an evolved pedagogy. We can thus make sense of the developmentally and contextually calibrated boredom and thrill of play as motivational and regulatory mechanisms designed to optimize the kind of learning that benefited our ancestors in the environment of evolutionary adaptedness.

In representational art, aesthetics and play join forces. When engaging with an artistic representation, such as Keats' Grecian urn, the mental spaces created are neither precisely counterfactual (they not primarily contrasted with a real state of affairs) nor

hypothetical (they are not primarily formulations of a possible state of things). Rather, they are defined in a deliberately playful manner to optimize the conditions for self-construction. A striking feature of this optimization is the creation of virtual agents, which permit an intense and likely extremely effective first-person learning.

Consider the situation when you encounter real human beings. You know they see you, and that what you do will make a difference. In order to act coherently, you need to track who you are, what your goals are, along with your available resources and possible obstacles. These elements constitute what we may term your agent memories. When you encounter a human being in a piece of representational art, you realize that there is no need to respond to him or her – the person isn't there, it's just a picture. She cannot see you, and you are not called upon to act. In this case, what do you do?

First of all, you may lower your defenses and enter an aesthetic frame of mind; this may play a role in the effective implicit information gathering. Because you do not need to respond, you may set your own agent memories aside—an act that frees you from worrying about the real problems in your life. In this way, the aesthetic attraction and imaginative possibilities of the object teases you out of thought, to use Keats' expression. Secondly, you may use your imagination to fill in the blanks, to attempt to reconstruct a past and a future that fits the cues provided. In doing this, you are in effect constructing a model of the fictive agents in the representation, attributing to them a social and biological identity, a goal, and a set of resources and obstacles relating to reaching this goal. This act of reconstruction creates a complete set of agent memories—wholly fictive of course, and attributed to the individuals depicted. In the third stage, you may swing your wand and undergo yourself a temporary transformation into the person represented, handled either as a personal identification or an imaginative projection. You do this by as it were

writing your own agent memories to disk and reading in the fictive ones you constructed in stage two, thus becoming a virtual agent. By creating a virtual agent, you are able to enter the fictive scenario and contemplate from a first-person perspective the full experience presented in the representation.

This virtual agent allows the pretending individual to use fiction to access and to explore the vast space of possible human action. Human beings are not born with operating manuals, and the competitive nature of social and natural reality means that there will always be a premium on new and original strategies of action. Discovering the small subset of useful strategies among the vast number of possible actions is a non-trivial problem, especially in domains where the cost of an attempt is high and the tolerance for failure low. In pretense, we can explore this abstract and unmanifest but nevertheless real phase space of human thought, feeling, and action in a manner that is safe and sheltered from real consequences, and we can do so at a negligible cost. Great representational art, in this perspective, provides a set of affordances that allow us to open up this phase space in new and original ways, suited to our local individual and cultural conditions.

Conclusion

If we accept to use the term "beauty" for whatever qualities it is that attract us to aesthetic objects and events, we can now return to the question raised by Keats' ode: what kind of truth is beauty? In the first approximation, this model of natural aesthetics suggests that beauty can meaningfully be thought of as an important type of truth. Referential truth makes a claim about a systematic relation between an external manifest and an internal symbolic order; in natural aesthetics, there is no symbolic order. Instead, aesthetic truth makes an even more basic claim: that there is a significant and systematic relation between certain orders that are externally manifest and the internal manifest order of certain aspects

of our being. The truth of beauty, in this view, is that particular subset of truths that we are designed to feel inclined to seek out and enjoy as an end in themselves, and that are relied on by the organism and by natural selection for the purpose of constructing and maintaining our own order.

In the second approximation, the truth of beauty encompasses the use of imaginative immersion and the creation of virtual agents in representational art. In this case, beauty's claim to truth is more diffuse. It is centered in the proposition that the set of actions, thoughts, and feelings—modes of relating to the world—that are possible but not yet manifest or realized constitutes a genuine and important truth. It has supreme practical value, for it is in this phase space that new strategies can be found. Art provides us with the occasion and some of the tools to explore this possibility space in ways that are cheap, safe, and effective.

Both of these types of truth – the aesthetic and the imaginative – are precarious. It is not the case, *pace* Keats, that aesthetics and the imagination are the only kinds of truth we have or the only kind we need. This matters, as they are not infallible paths to truth. First, the processes of natural selection that have endowed us with these admittedly very powerful modes of acquiring truth are effective only with regard to truths that have persisted and mattered for survival for very long periods, and even then only to some pragmatic degree of approximation. Second, cultural innovations in the arts rely in part on deliberately exploiting the slack in our adaptive machinery; in these cases, the truths we discover, if any, can be chalked up to our own account. Third, the fact that the real work of beauty takes place in large part below the horizon of conscious awareness, but according to principles that can be at least in part discovered, creates a situation where the instinctive conviction that beauty is truth lends itself to manipulation for political and other

purposes. Finally, according to the present argument, the very design of aesthetics and imaginative play is to explore a vast phase space of human action, much of which has not been realized and thus cannot have been acted on by natural selection. In brief, we are on our own. Beauty is a profound guide to a kind of truth we might term "existential": if it has a referent, it is the order that unites us with the cosmos.

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(In the final manuscript, the references will be combined into one section at the end of the book.)

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