

Half a Million Years of Art History

How the Human Origins of Art Can Change Arts Education Today

by Jeff Lieberman and Eric Gunther

Originally published in
*20UNDER40: ReInventing the Arts and
Arts Education for the 21st Century*
Edited by Edward P. Clapp

Abstract

To move the arts and arts education into the future, we must look millions of years into the past, into the evolutionary history of our species and the role the arts have played in making us human. We are faced with unprecedented opportunities for a new symbiosis between the arts and sciences. For these two disciplines to assume their rightfully vital places in the education of future generations, they must acknowledge their mutual interdependence. Arts education must acknowledge and teach the science of beauty and science education, the beauty of science.

Acknowledgements

The authors would like to thank Ellen Dissanayake, Frederick Turner, and E. O. Wilson, not only for their useful feedback, but for their refreshing visions of the past and the future. Thanks to Fardad Faridi for the beautiful illustrations, Markos Hankin for the photo, and to our friends and family for their insightful feedback.

We cannot hope to understand these strange beginnings of art unless we try to enter the mind of the primitive people and find out what kind of experience it is which makes them think of pictures, not as something nice to look at, but as something powerful to use.

—E.H. Gombrich¹

At the age of 31, the French composer Olivier Messiaen was captured by the Germans and forced via cattle-car into a concentration camp. Borrowing a pencil from a guard, he composed a piece for himself and three musicians from the camp. Originally performed for guards and thousands of prisoners, the “Quartet for the End of Time” has become a celebrated work of art.² Under the constant threat of freezing, torture, and starvation, he spent his valuable energy and time writing music. By no means is this rare—in dire situations from slavery to natural disasters to war, people make art. Why do we bother?

We bother because we have to. Art is a human instinct.

Infants behave artistically, yet by adulthood many Americans are embarrassed when asked to sing, dance, or paint. Third world cultures rarely exhibit this kind of inhibition. Americans don’t recognize that art is a need and so it has been pushed to the edges of our culture and our educational system. If we can demonstrate that art is not a frill, but rather essential to life, we have the potential to fundamentally change arts education, and through that, our culture. But how can we do that?

To move art education into the future, we must look half a million years into the past. We must recognize art not as a job, hobby, or object, but as a human behavior. We know plenty about how art is made; it is time we knew why.

But why do we care about what happened half a million years ago? We have ample anecdotal evidence and intuition that the arts are important to our well being. The sciences deepen the story of art, with an historical account of how the arts were pivotal to our species’ survival. But knowledge is not enough; if we don’t foster the artistic instinct, it will disappear. Arts education is essential for keeping this primal essence of the arts within our cultural grasp. For hundreds of thousands of years, the arts honed our intelligence, driving the cultural and technological development of our species. We have no reason to doubt their potential now.

Mentioning science and art in the same sentence can lead to apprehension. People worry that a scientific approach to the arts will demystify the beauty, and remove the “art” from the arts. But it hasn’t always been this way. Aristotle and da Vinci saw the deep connections between the arts and sciences. Modern science may substantiate these connections. How exciting would it be to trace Rembrandt’s masterful use of chiaroscuro past the Greeks, all the way back to the funeral rites of early humans?

Our primary goal in this chapter is to make new developments in the science of art relevant to any discussion of the future of arts education. We begin by surveying theories on the evolutionary origins of art. We then explore the implications these theories have for arts education today. Finally, we suggest that as art education opens its eyes to the science of art, science education can open its eyes to the art of science. This symbiosis is not only possible, but vital to education.

The Origins of an Artistic Species

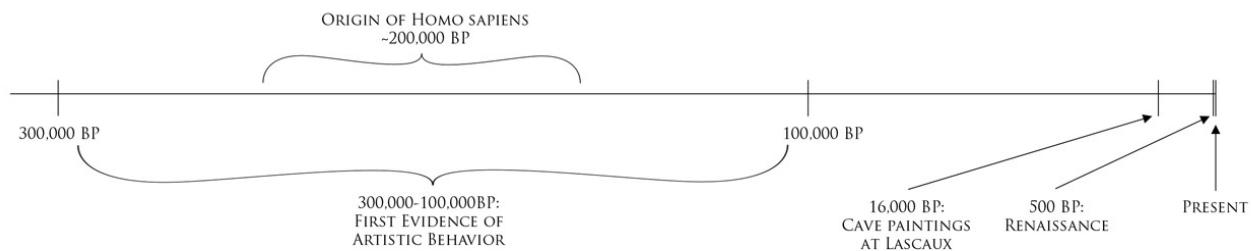


Figure 1. The history of art, an approximate timeline (BP = years before present). Note there are two lines representing the Renaissance and the present. Museums have been around for about the last mm of this figure.

As we surf the net, watch TV, and listen to the radio, we fail to observe the long stories behind everything we do. Aspects of our daily life that we take for granted have only been around for one ten-thousandth of humanity's history. Our evolutionary line separated from the great apes about 4 million years ago. For the first 3.9 million years, our ancestors lived exclusively in nomadic hunter-gatherer societies of a few dozen people. Since Darwin published *On The Origin of Species* over 150 years ago, we have learned that, whatever else we may have become, we are still animals. And evolution shapes us—not only our bodies, but our behaviors.

In the last 30 years the field of evolutionary psychology has begun to examine the evolutionary roots of our behavior. Though evolutionary psychology is still viewed as controversial by some, it nonetheless serves as an avenue of study that helps us ask important questions such as "why did human beings

start making art?" If art can be shown to have evolved as a behavior, to have played a critical role in our development, the implications for our understanding of the arts are enormous.

How can we discuss the future of arts education without understanding what art is and why we make it? In art history class, we study paintings, sculptures, dance, music, and poetry from the last 2,000 years, but works of art have been experienced in museums, theaters, and concert halls for less than 1% of human history. What about the 300,000 years of ritual that led to these artifacts? How can we truly understand what art is without understanding the evolutionary forces that spawned it?

Before we continue, a review of natural selection is in order. *Natural variation exists in any population*—look around you. *Traits are heritable*, that is, “you have your father’s eyes, and your grandfather’s male-pattern baldness.” Finally, *some of these variations contribute to an organism’s survival*. When leaves are dwindling, the giraffe with the longest neck wins.

The organisms with the beneficial traits (like our giraffe) will tend to reproduce slightly more often. Over many generations these traits tend to spread through the entire population. Even small advantages grow at an accelerating rate, like money in a savings account.

We tend to find pleasure in behaviors that aid our survival. The more your ancestors enjoyed sex, the more likely you were to be born.

This applies everywhere. Play enables cats to practice hunting in a situation without serious consequences. The cats that enjoy playing become better hunters in real life because they enjoy practicing.

A behavior that is universally found in our species, especially one that costs energy and is pleasurable, probably served a critical role in our development. The behaviors we call “art” are found in every known human culture on the planet. We expend enormous amounts of energy on them. And without question they feel good.³ If our logic is correct, this means the arts were vital to our survival.

Making such a statement, however, leads us to the question: how exactly did the arts help our species survive?

Current Theories

Darwin himself believed in the evolutionary origins of art, attributing them to *sexual selection*.⁴ The peacock tail provides a classic example. If a male can survive with such a "splendid monstrosity" it advertises to females, "See what a strong, healthy peacock I am."⁵ Health is attractive.

The last 150 years have yielded many new theories on the evolutionary origins of art. Below are some of our favorites...

Edward O. Wilson

The cave paintings at Lascaux, estimated to be 16,000 years old, depict animals hunted by human weapons. They are not special simply because of their age. To understand these paintings we must put ourselves into the bare feet of the Paleolithic men and women who made them. These people believed that symbols influenced the objects they represented, and that by painting animals and killing their images, they would have control over the real animals. The arts were magic.

However, the real magic of the arts happened not on the hunt, but in the hunter. The arts alleviated the crippling side-effects of human intelligence: the understanding of the uncon-

trollability of nature and the recognition of our mortality. We are the only animal with an awareness of our inevitable death. The arts were spawned by the need to "impose order on the confusion caused by intelligence."⁶ In diminishing this anxiety, humans transcended the "fight or flight" instinct to give themselves a Darwinian selective advantage.

Wilson talks about reoccurring themes in the arts. As humans, certain thoughts and behaviors enter our minds more frequently than others and are more likely to stir our emotions. These behaviors bias cultural evolution toward the invention of archetypes. Looking at myths across cultures, we see the same underlying stories told in different ways.

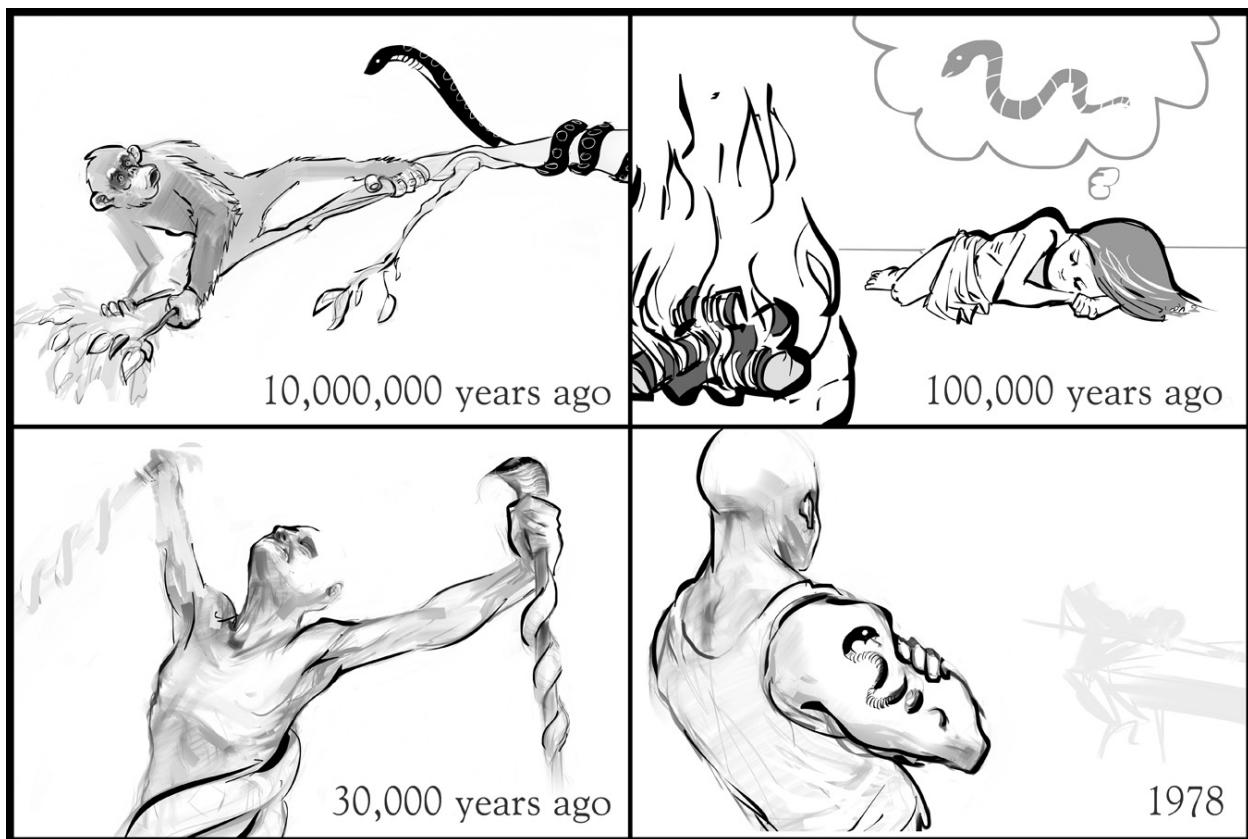


Figure 2. A Natural History of the Serpent: Chimps have a healthy fear of snakes. Through dreams and myth, the serpent has become a potent cultural symbol. (Image courtesy of Fardad Faridi)

For example, serpents are present in the mythologies and dreams of nearly every culture ever studied.⁷ Looking at our distant ancestors, a reason immediately suggests itself: chimps were often killed by snakes. Chimps alive today are the ones whose ancestors developed an inherent fear of snakes. They are born afraid of snakes because it benefits their survival. To this day, a chimpanzee most violently fears the most poisonous snakes, even on first encounter.⁸ This fear took on strange new forms through the evolution of human consciousness and culture. The images and mythology

spawned by this fear continue to suit our survival, by honing our awareness of something dangerous.

Wilson distills the arts into a process: *imitate, make it geometrical, intensify*. How we do this is based on our real, existing human nature, a picture of which is emerging in the evolutionary sciences. As Wilson hypothesizes, the motivations for even the greatest works of art might be understood with knowledge of the biologically evolved rules that guided them.⁹

Ellen Dissanayake and “Making Special”

Almost 300,000 years ago we find evidence of one of the earliest seeds of artistic behavior: people covering their bodies with red ochre, a natural pigment. This tendency to make things special, to shape aspects of their world in a way that makes them extraordinary, represents the core of art to Ellen Dissanayake.¹⁰

To her, the arts are ordinary behaviors and objects that are made special, through exaggeration, embellishment, repetition, inversion, and shaping. Normal movement is turned into dance. Spoken language is patterned into poetry. Intonation is shaped into song. Objects become the visual arts. These transformations are anything but arbitrary.

It is no coincidence that we perform artistic behaviors in potentially stressful situations: life transitions and events such as birth, puberty, marriage, curing the sick, and finding food. It is here where the selective value of the arts is most apparent, in three distinct ways.

First, as Wilson suggests, these actions fulfill our imperative to “do something” beyond the instinct of fight, flight, or freeze.¹¹ Whether these actions control the environment is secondary. They give us the illusion of control. We see the seeds of these behaviors in caged animals who calm themselves through pacing and repetitive rocking. We are their descendants.

Furthermore, when we make objects and activities special, we make them better. Archeologists find tools with exquisite markings on them, serving no direct utility .



Figure 3. Dissanayake sees the evolutionary origins of music in the babble talk between mothers and infants.

Dissanayake believes that those who felt the impulse to make the tools special with decorations instinctively spent more time and energy developing them.¹² Tools made special are tools made better.

Finally, rituals serve to pass cultural traditions from generation to generation. The arts make this transfer of vital cultural information effective. Picture a shiny ripe apple or a glossy supermodel. The natural human attraction to smoothness, symmetry, shine, color, and lack of blemish is no accident. These are indications of health. Works of art that embody these features become exceptionally compelling and memorable.

Dissanayake stresses the power of these artistic behaviors and rituals to solidify the tribe.¹³ Natural selection works at the level of the group in addition to the individual. The whole can be greater than the sum of its parts and the health of the tribe translates to the health of its members.

The key is that *art is a behavior, rather than the results of that behavior*. Engaging in the arts was crucial to human survival.

Frederick Turner and Beauty

Look closely at a tree. At a leaf. A feather. A man. From atom, to molecule, to DNA, to cell, to human, to society, and beyond, we are structures built upon structures. Though they may differ on the surface, internally these structures follow certain patterns. Frederick Turner believes that our ability to detect such underlying patterns is what we often experience as beauty.¹⁴ The arts reflect this ability.



Figure 4. From trunk, to branch, to leaf, trees show similar structures upon structures.

Just as we evolved a pleasurable feeling from eating as a reward for acquiring food, we find pleasure in beauty. Like a drug, it triggers neurotransmitters in our brains. But why is the *experience of beauty* useful? Turner's answer is nuanced and complex, tying together anthropology, neuroscience, chaos theory, mathematics, and ecoscience. Here is a brief summary.

Try to remember this sequence of letters: wethepeopleoftheunitedstatesofamerica. This is almost impossible, until you see the underlying structure of the information. As soon as you recognize the words instead of just the letters, your brain represents the information on a higher level, and it becomes easy to remember—and to share with friends. Now try this instead: fdbwyarpgtorwrtblmasdbhasalfah.

To Turner, the experience of beauty is this perception of structure.

Genetic changes take hundreds of generations, but culture can shift enormously within a single lifetime. Between 1 and 5 million years ago, the ability to transfer cultural information became a dominant force in evolution. We take it for granted, but it is an enormous challenge for an animal to transfer knowledge from one generation to the next. Imagine a hunting strategy 100,000 years ago, improving continuously through human ingenuity and innovation. As

strategies evolved, those that could see the underlying structure would be able to understand them more easily.

Beauty is pleasurable because the better we can sense structure, the easier we can adapt to changes in the details. In this view, beauty and the aesthetic sense represent our “highest integrative level of understanding” of the world around us.¹⁵

The scientific search for the origins of art has just begun—and these three approaches represent only a sampling of a much larger conversation. However, regardless of the details, each of these theories points to the significant role the arts played in defining what it means to be human. If there is any truth to these claims, our current valuation of arts education is completely disconnected from our artistic heritage. Collectively, these theories scream out for a reevaluation of arts education in America.

It is time art education reflects the first 90% of the history of art.

To the Past, for the Future

There is typically a palpable resistance among arts and humanities communities to the application of science to their field. The skepticism towards Darwin's theory of evolution in some parts of the United States only stiffens this resistance. Pressing the scalpel of science into the warm clay of art becomes a delicate affair. For science to make its case, it must speak for the arts, not at them. However, the effort is worth it: the science of art has the potential to justify what many have been feeling by intuition for centuries, that the arts are vital.

How can such an evolutionary view amend current attitudes towards art? And how can it provide answers for the future of arts education? Let us consider the current state of the arts in America, and look at some familiar diagnoses for art education in light of the new science.

The Arts Are a Process, Not a Product

A painting, a performance, a poem—today, most people see art as a product. And we value that product: velvet ropes guard our sculptures. But the arts evolved hand in hand with human ritual. They were born as behaviors for the benefit of the participants, not of a removed third party. The arts are a process, inseparable from the social traditions that bred them.

The evolutionary view of the arts shows the need for people to *do* art, not just to *observe* it. As art historian Ernst Gombrich puts it, there really is no such thing as Art. There are only artists.¹⁶ In our current museum culture, we revere the object on the pedestal. But the object was only made because *making* it served a purpose.

Art Is for Everyone

Remember feeling the cold sweat of terror at a high school dance? Today, many of us are scared to express ourselves artistically. We fail to see ourselves as artists. But 100,000 years before anyone sat still in a theater to watch a dance performance, we danced together.

The evolutionary view of the arts shows that art is a behavior that belongs to every human, akin to laughing, learning to walk, or eating. This is still evidenced in many developing countries, where participation in the arts is ubiquitous. Without being coaxed, infants in every culture sing, dance, and scribble. A central goal of arts education should be to extend this instinct throughout our lifetimes. To be human is to be an artist. When we deny our artistic impulse, we diminish our humanity.

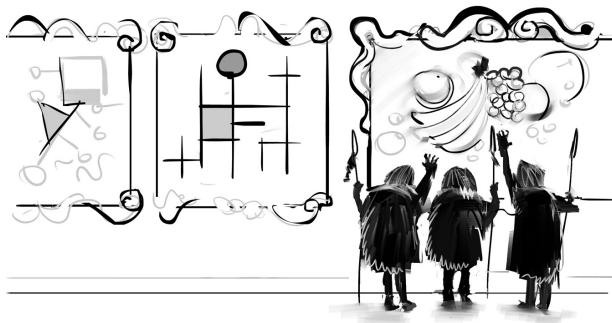


Figure 5. (Image courtesy of Fardad Faridi.)

I do not think there are any wrong reasons for liking a statue or picture.

—E.H. Gombrich¹⁸

Art Appreciation Is for Everyone

How many people feel qualified to have an opinion about a Rothko painting? The “high arts” of today are often “more occasions for perplexity than avenues to insight.”¹⁷ It seems as though an extensive education in the arts is required to emotionally connect with much of contemporary art.

Taking an evolutionary view of the arts shows that our gut reactions to works of art are legitimate and need not be justified with words. Whether or not you consider it “Art,” you can certainly remember the last movie that hit you in the gut.

The Arts Are Therapeutic

Americans are not as happy as their superpower status may lead one to believe.¹⁹ Perhaps the dwindling of the arts is partly to blame. But in giving form to and controlling our worries, the arts evolved primarily to alleviate our anxiety as a species.

Hopefully we have all experienced, at least once, the ecstasy of dancing. Communal pleasures “ranging from simple festivities to ecstatic rituals” have alleviated and even cured depression in a variety of cultures. For example, Barbara Ehrenreich directs our attention to case studies such as “Christian Uganda in the 1990s, [where] dance rituals were used to help rehabilitate severely withdrawn children traumatized by their experience as captives of the murderous guerrilla movement known as the Lord’s Resistance Army.”²⁰

We tap our toes and drum our fingers when we are impatient or worried, and our chimp ancestors rhythmically run about, slap the ground, and scream in thunderstorms. From the Great depression to 9/11—and all the way back through the Pleistocene epoch—we turn to the arts in times of trouble. In the modern age, many are explicitly turning to art for therapy. Maybe the cure to our depressed, anxious society is staring us in the face.

Art Is Not Arbitrary

The arts express the common themes of the human species. As shown by our myths and archetypes, our brains and bodies are biased towards certain aesthetic experiences. For example, studies have shown that newborn infants have similar artistic preferences.²¹ Furthermore, research in poetics and neuroscience suggests that much of the world's poetry universally has a three second line length that corresponds to the three second short-term acoustic memory in our brains.²² Poetry is what it is because it leveraged this biological fact.

We evolved with the arts; and the arts evolved with us. The evolutionary view shows us that art is defined by its ability to affect us. The arts stem from our biology.



Figure 6. Art comes from our biology. Across cultures, the length of a line of poetry is roughly 3-seconds, corresponding to the short-term processing length of the audio cortex.

The Arts Develop Unique Forms of Intelligence

In America, the arts are not properly appreciated as a valid form of intelligence. The presence of the arts across all cultures, however, indicates that they very likely provided a cognitive advantage.²³ Frederick Turner suggests that our sense of beauty is no less than our ability to sense the fundamental organizing principles of the universe.

The arts function as an orthogonal means of knowing the world, vital to our survival.²⁴ They uniquely amplify a child's understanding of self and the world, expanding what it means to "know" something—you cannot learn to dance, for example, by reading a book.²⁵ Of the eight forms of intelligence originally identified by developmental psychologist Howard Gardner, roughly half are correlated with artistic behaviors, a fact further bolstered by brain imaging studies.²⁶ For example, neuroscience research suggests that musicians "show engagement of a broader area of the same parts of the brain used by those less able."²⁷

To make the case for the arts in education, Charles Fowler believes that we will have to show both schools and industry that the arts can serve our country in ways that will enhance education, life, and the ability of people to be productive citizens.²⁸ The arts might not lend themselves to standardized testing, but for hundreds of thousands of years, they have played a role in cultural and even technological evolution. As Dissanayake suggests, those with an artistic attitude towards their craft tended to be most successful. If the arts enabled the success of both tribes and individuals throughout the history of human evolution, they can continue to do the same for us today.

For many arts educators, the above arguments are intuitively obvious. By tracing these arguments to our human origins, the science of art can rewrite the story of art education in America. But where do we start?

Poetic Science

Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution. It is, strictly speaking, a real factor in scientific research.

—Albert Einstein²⁹

Our popular view of the daydreaming artist covered in paint, and the analytic scientist with her petri dishes illustrates an exaggerated dichotomy. They have different methods and different goals, but both seek truth. Both draw from the same “subconscious wellsprings” and both seek elegance.³⁰ From Aristotle to da Vinci, the early sciences were intimately tied to the arts, and many artists have foreshadowed major scientific discoveries.³¹

As much as the sciences may reinvigorate arts education, the arts have the potential to revitalize science education. Though science education is clearly well funded in America it is a relatively new and often unfamiliar way of thinking. Quantum physics, for instance, isn't the easiest thing for our 200,000-year-old caveman brains to process.

On one hand, the sciences, as Wilson explains, are intended to generalize, to distill the laws of nature. On the other hand, the arts have evolved to share knowledge in a way that intensifies aesthetic and emotional response.³² The arts are defined by their ability to compel us and by our ability to remember them.³³ Artistic “knowing” represents a truly different form of intelligence, one that is often ignored—even distrusted—by scientifically-minded individuals. In retrospect, scientific discovery might look like a clean, forward-moving procession of

experimentation and discovery. In reality, accidents and subsequent insights lead to major scientific revolutions.³⁴ While we often teach the “facts, facts, facts” of science, the revolutions come from intuition, from creativity, from speculation, from leaps of imagination.³⁵

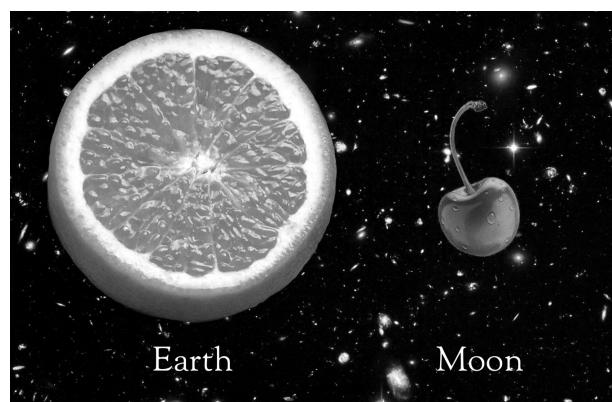


Figure 7. Cosmic Fruit: If the earth were an orange and the moon a cherry, they would be ten feet apart. Visual metaphor allows us to comprehend numbers like 400,000,000 meters, the real distance between earth and the moon.



Figure 8. MIT professor Walter Lewin, teaching pendulum physics with gusto. (Photo: Markos Hankin)

Science teaches us about the universe around us—but the universe of the atom, the DNA strand, and the supernova is not the universe of direct experience. Our bodies are not emotionally tuned to information on these microscopic and cosmic scales. Perception has been with us for millions of years, science for thousands. It is only through metaphor that we can understand these colossal concepts. Einstein, for example, grasped the theory of relativity by imagining himself on a moving train.

Analogy is the common human origin of science and art. It is in fact a fundamental mechanism of mind, the “consequence of spreading activation of the brain during learning.”^{36, 37} Everything we know, we learn by analogy with what we already know. Analogy allows us to concretely grasp abstract concepts, relating them to direct experience, just as art allows us to express the universal through the particular. This means that the arts train the fundamental abilities of the sciences.

Some of the brightest scientists, including Albert Einstein and Carl Sagan, showed us the emotional depth of science. Five hundred years ago, Francis Bacon advocated for the use of illustrations, stories, and fables to give science the same emotional punch as the arts.³⁸

As much as demonstration improves learning over mere explanation, our emotional participation considerably improves our understanding.³⁹ Our brightest science teachers give us drama.

By tuning towards what interests us as humans, the arts can generate excitement about science.

Beauty and Truth

The greater one's science, the deeper the sense of mystery.

—Vladimir Nabokov⁴⁰

Remember the last time you stood before a canvas at a museum and took one step back. A squint of the eyes—the brush strokes fade and figures emerge. Another step—the scene begins to coalesce, the colors blend. The painting changes, not because the paint has changed, but because your perspective has. The science of art does not take away the mystery, it deepens our perspective. It allows us to step back further than the walls of a museum can ever allow.

How can we live with an educational system that denies a fundamental piece of what it means to be human? What greater argument can we make for supporting the arts than to show that it is essential to the long-term health of our species?⁴¹ Given this, are the arts somehow less important than the sciences, than social studies, than math?

It is ironic that the very traits of our nation that steer us away from art—an obsession with reason and quantifiable progress—can steer us back toward art, toward an ancient well of emotional and spiritual well being. And what deeper message of tolerance and oneness can we send to children than that of the arts as a behavior that unifies humanity?

When will there be a “Natural History of the Arts,” a textbook addressing not only the physical origins of art, but its biological and mental underpinnings? Students will never hear of such theories until art educators become familiar with an evolutionary view of the arts and incorporate this perspective into their curricula. By doing so we have the opportunity to encourage an anthropological spirit in young art students. The study of arts practice as well as the study of art history can

begin with a new first chapter, one that starts 300,000 years before the cave paintings.

Scientific developments present an opportunity to soften the boundaries between art and science education. We should not be hesitant to bring science into the arts classroom. Imagine an art and science month at every high school, where art and science teachers work together, covering the intersections between their subjects. Imagine a biology teacher discussing how human Gestalt theory influences our perception of Monet’s work, or a ballet teacher explaining how ancient Indian dance rituals strengthened the communal ties of the tribe.

Lobbying efforts to expand art education in America can be reinvigorated by the science of art, and by a reevaluation of the biological history of the arts and the development of our species. The evolutionary view of the arts gives educators and lobbyists a new source of evidence to draw upon in their advocacy efforts. But like scientific discoveries, education reform can take decades to find its way into public policy. Now is the time to plant the seeds.

Art education can blossom with science. Science education can thrive with art. New developments in the science of art should be part of every discussion of the future of arts education.

The Authors

Jeff Lieberman was born in Miami in 1978. He has degrees from MIT in physics, mathematics, mechanical engineering, and robotics, and spends most of his time exploring ways in which the arts and sciences can be brought together. He hosts the Discovery Channel television show "Time Warp," using modern technologies such as slow motion video to show the extraordinary world beyond the normal range of human perception.

He publishes photography, builds kinetic sculpture internationally, and makes music, primarily as half of the duo gloobic. He collaborates extensively with Eric Gunther and is a co-founder of Plebian Design.

jeff.lieberman@gmail.com
www.bea.st

Eric Gunther was born in New York in 1978. He studied Computer Science and Electrical Engineering at MIT, where he also did his Masters in tactile composition. He lives in Cambridge, Massachusetts, where he is co-founder of the art and design firm Sosolimited. For seven years, Eric was Art Director at Small Design Firm, where he created interactive installations for clients around the world.

He builds vibrotactile sculptures and is interested in creating new aesthetic experiences for the body using technology. Eric has done sound design for radio and documentary, and is a prolific musician. He is half of the band gloobic and an artistic collaborator with Jeff Lieberman and Plebian Design.

gunther.eric@gmail.com
www.ericgunther.info

Notes

1. Gombrich, E.H. *The Story of Art: Pocket Edition*. New York: Phaidon, 2006: 38.
2. Paulnack, K. "Karl Paulnack Welcome Address." The Boston Conservatory (2004), <http://www.bostonconservatory.edu/s/940/Bio.aspx?sid=940&gid=1&pgid=1241>
3. Dissanayake, E. *Homo Aestheticus: Where Art Comes from and Why*. Seattle: University of Washington Press, 1995.
4. Darwin, C. *The Descent of Man, and Selection in Relation to Sex*. London: John Murray, 1871.
5. Dutton, D. *The Art Instinct: Beauty, Pleasure, and Human Evolution*. New York: Bloomsbury Press, 2010: 136-138.
6. Wilson, E.O. *Consilience: The Unity of Knowledge*. New York: Random House, 1998: 225.
7. Ibid.
8. Ibid.
9. Ibid.
10. Dissanayake, E. *Homo Aestheticus: Where Art Comes from and Why*. Seattle: University of Washington Press, 1995.
11. Wilson, E.O. *Consilience: The Unity of Knowledge*. New York: Random House, 1998
12. Dissanayake, E. *Homo Aestheticus: Where Art Comes from and Why*. Seattle: University of Washington Press, 1995.
13. Ibid.
14. Turner, F. *Beauty: Value of Values*. Charlottesville: University Press of Virginia, 1992; Turner, F. "An Ecopoetics of Beauty and Meaning," in Cooke, B. and Turner, F. (Eds.) *Biopoetics: Evolutionary Explorations in the Arts*. Kentucky: ICUS, 1999: 119-138.
15. Ibid. : 125.
16. Gombrich, E.H. *The Story of Art: Pocket Edition*. New York: Phaidon, 2006.
17. Dissanayake, E. *Homo Aestheticus: Where Art Comes from and Why*. Seattle: University of Washington Press, 1995: xiv.
18. Gombrich, E.H. *The Story of Art: Pocket Edition*. New York: Phaidon, 2006: 21.
19. Veenhoven, R. "World Database of Happiness." Erasmus University Rotterdam (2010), <http://worlddatabaseofhappiness.eur.nl>
20. Ehrenreich, B. *Dancing in the Streets: A History of Collective Joy*. New York: Metropolitan Books, 2007: 151.
21. Smetz, G. *Aesthetic Judgment and Arousal: An Experimental Contribution to Psycho-aesthetics*. Leuven: Leuven University Press, 1973.
22. Turner, F. "An Ecopoetics of Beauty and Meaning," in Cooke, B. and Turner, F. (Eds.) *Biopoetics: Evolutionary Explorations in the Arts*. Kentucky: ICUS, 1999: 119-138.
23. Cooke, B. "Biopoetics: The New Synthesis," in Cooke, B. and Turner, F. (Eds.) *Biopoetics: Evolutionary Explorations in the Arts*. Kentucky: ICUS, 1999: 3-26.
24. Ibid.
25. Kagan, J. "Jerome Kagan on Why the Arts Matter." The Dana Foundation (2009), <http://www.dana.org/news/features/detail.aspx?id=21740>
26. Gardner, H. *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books, 1993.
27. Wilson, E.O. *Consilience: The Unity of Knowledge*. New York: Random House, 1998.

Notes

28. Fowler, C. *Strong Arts, Strong Schools*. New York: Oxford University Press, 1996.
29. Einstein, A. *Einstein on Cosmic Religion and Other Opinions and Aphorisms*. New York: Dover, 1931: 97.
30. Wilson, E.O. *Biophilia*. Boston: Harvard University Press, 1984: 62.
31. Lehrer, J. *Proust Was a Neuroscientist*. Boston: Houghton Mifflin Harcourt, 2007; Onians, J. *Neuroaristotle: From Aristotle and Pliny to Baxandall and Zeki*. New Haven: Yale University Press, 2008.
32. Wilson, E.O. *Consilience: The Unity of Knowledge*. New York: Random House, 1998.
33. Dissanayake, E. *Homo Aestheticus: Where Art Comes from and Why*. Seattle: University of Washington Press, 1995.
34. Kuhn, T. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1996.
35. Judson, O. "License to Wonder" New York Times (November 11, 2009), <http://opinionator.blogs.nytimes.com/2009/11/03/license-to-wonder/>
36. Lakoff, G. *Metaphors We Live By*. Chicago: University of Chicago Press, 1980.
37. Wilson, E.O. *Consilience: The Unity of Knowledge*. New York: Random House, 1998: 218.
38. Ibid.
39. Cooke, B. "Biopoetics: The New Synthesis," in Cooke, B. and Turner, F. (Eds.) *Biopoetics: Evolutionary Explorations in the Arts*. Kentucky: ICUS, 1999: 3-26.
40. Nabokov, V. *Strong Opinions*. UK: Vintage, 1990: 45.
41. Cooke, B. "Biopoetics: The New Synthesis," in Cooke, B. and Turner, F. (Eds.) *Biopoetics: Evolutionary Explorations in the Arts*. Kentucky: ICUS, 1999: 3-26.