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Your Aesthetic Brain: A Growing Case for the Arts

Neuroaesthetics is a new and rapidly expanding field of research that is aimed at the intersection of psychological aesthetics, biological mechanisms, and human evolution. Our author, a force in facilitating research and practice in this young and exciting field, tells us how music, art, theater, dance, literature, landscape, and media have the power to help treat any number of disorders and improve one's quality of life.



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Think back to a time in your life before deadlines rolled in relentlessly and smartphones kept you tethered to an endless list of to-dos. Do you remember having space and time to explore the world through all your senses? To play without keeping score and to create without boundaries? To literally stop and smell the roses?

For some of us, to recall that time of joy and wonder we have to dive deep into our reservoir of childhood memories for the best moments. For others, it's as easy as listening to a favorite piece of music, watching a stunning sunset, or dancing the night away.

As a child, I savored my freedom to explore and create, making necklaces from dandelions and clover, inhaling the smell of a thunderstorm approaching and creating stories from shadows cast on my bedroom walls. That drive to behold and create aesthetic experiences permeated everything in my life and has enriched me throughout it, expanding to many art forms.

The truth is that aesthetic experiences—and the arts—are hard-wired in all of us. They are evolutionary imperatives, encoded in our DNA as an essential part of our humanity. And they are fundamental to our health, well-being, and learning.

While artists have always intuitively understood these truths, our scientific understanding of the arts is relatively new. The field of neuroaesthetics, situated at the crossroads of brain sciences, technology and the arts, is on a quest to explore their full potential.

The Arts: An Evolutionary Superpower

The way in which the arts are reinforced in the brain—through reward, pleasure and fear circuitry— confirms their link to our survival as a species, according to evolutionary biologist E.O. Wilson. The arts still serve the same primal function today—helping us to communicate and connect—much as they did in our evolutionary past.

We are exquisitely designed for aesthetic experiences, from the mundane to the sublime. In his book, *The Art Instinct*, philosopher Dennis Dutton argues that the drive to make art is encoded in our genes, going all the way back to the DNA of our earliest ancestors.

Anthropologist Ellen Dissanayake agrees that art has played an essential role in our evolution and ability to adapt. In 1995, she wrote in her book *Homo Aestheticus* that self-expression and the creation of art is a basic human need. Through her anthropological fieldwork, Dissanayake documented this universal artistic impulse in cultures around the world. She found that even nomadic peoples with few material possessions practiced personal adornment, decorating objects, and community rituals involving song and dance.

The arts have been used as healing tools throughout the ages, from the sacred chanting of Gregorian monks and Native American dance rituals to the present day. Yet despite the universal and ubiquitous utility of the arts, it's only over the past 15 years that scientific research has finally caught up to the notion that they are something we can't afford to live without.

Your Brain on the Arts

Aesthetic experiences, and their impact on the mind and body, are much more than the sum of individual brain regions or activities. Complex and sophisticated neural substrates and networks are created to achieve heightened states of connectivity.

Among the core neural mechanisms at play is the process of perception, by which external stimuli enter the brain and are processed through the pathways of the senses and the brain's perceptual systems. In his book, *Reductionism in Art and Brain Science, Bridging the Two Cultures*, Eric Kandel proposes that the co-mingling of our sensory and cognitive functions dictates perception. We take in the world through our senses and making meaning through cognition. The interplay results in an aesthetic experience unique to each of us.

Neuroaesthetic researchers are also studying the activation of reward systems and the default mode network when viewing or creating art. The reward system releases feel-

good brain chemicals like dopamine, serotonin, and oxytocin that trigger sensations of pleasure and positive emotions. We see these pleasure centers light up in the brain when we are both creating and beholding the arts or engaged in aesthetic experiences.

The default mode network, once associated solely with daydreaming, is now linked to many different functions core to human connection and well-being. These include personal identity, sense of meaning, empathy, imagination, and creativity as well as embodied cognition, which allows us to place ourselves in a piece of artwork and make us *feel* what the artist was feeling.

An Emerging Field of Study and Its Pioneers

This study of the intersection of brain sciences and the arts was first coined 'neuroaesthetics' in the late 1990s by Semir Zeki, renowned neuroscientist and professor at the University College of London. Much of the initial research focused on empirical aesthetics—examining the neural bases underlying how we perceive and judge works of art and aesthetic experiences.

At the University of California, San Diego, neuroscientist V.S. Ramachandran developed the "eight laws of artistic experience" to describe the core neural mechanisms underpinning our enjoyment of visual art. [In a paper](#) co-authored by William Hirstein, Ramachandran theorized that tactics employed by visual artists, such as the use of symmetry, balance, and grouping, generate an aesthetic appeal and pleasurable response for which the viewer's brain is exquisitely wired.

In the 1990s and early 2000s, French neuroscientist [Jean-Pierre Changeux](#) explored the role of memory and emotion in the contemplation of art. He hypothesized that the experience stimulated a complex mental synthesis involving the identification of forms, engagement of long and short-term memory processes, and recognition of the other as oneself, allowing us to link forms and figures to a larger meaning. Using fMRI, neuroscientists Ed Vessel from the Max Planck Institute for Empirical Aesthetics along with Amy Belfi at Missouri University of Science and Technology have expanded upon Changeux's foundational work, exploring the [default mode network's role](#) in the mental synthesis that ultimately shapes what we find most aesthetically meaningful.

But this new wave of research wasn't just concerned with visual art. In the 1980s, Robert Zatorre, a cognitive neuroscientist at McGill University in Montreal, began to study the neurological impacts of music. A music lover, Zatorre believed that understanding how we experience music on a neurological level could lead to a better understanding of the organization and structure of the brain writ large. "Increasing numbers of investigators are convinced that music can yield valuable information about how the brain works," he explained in a 2005 article published in the journal *Nature*. "They believe that the study of the brain and the study of music can be mutually revealing." Zatorre's work showed how

making and listening to music engages networks and functions across the brain, including those involved in learning and memory, pleasure and reward, and emotion, and in the case of playing music, sensory-motor integration.

Neuroscientist Anjan Chatterjee at the University of Pennsylvania, along with others, further defined the experience of art as a [triad of sensation, emotion, and meaning](#). He proposed that an aesthetic event triggers a somatic, emotional response that leads to a sense of deeper personal significance. When you are immersed in an aesthetic experience, you can *feel* it. The effect on body and mind is both profound and highly personal.

Antonio Damasio, a noted neurologist studying the neural systems which underlie emotion, decision making, memory, language and consciousness at the Brain and Creativity Institute at the University of Southern California says, “Joy or sorrow can emerge only after the brain registers physical changes in the body.” He continues, in a [Scientific American Mind interview](#), “The brain is constantly receiving signals from the body, registering what is going on inside of us. It then processes the signals in neural maps, which it then compiles in the so-called somatosensory centers. Feelings occur when the maps are read and it becomes apparent that emotional changes have been recorded.”

Neuroaesthetics Evolves

Today, the field has evolved beyond its initial scope with a growing body of evidence demonstrating the direct impact of the visual arts, architecture, design, digital media, and music on the human brain, biology, and behavior.

For neuroaesthetics researchers, identifying the systems and brain mechanisms that respond to the arts is like finding a map to a hidden treasure. Cutting-edge brain research is revealing in greater detail how aesthetic experiences enter the brain through the portal of the senses, and—whether we’re aware of it or not—profoundly impact our biological circuitry. Scientists can now identify biomarkers that offer objective, measurable ways to characterize changes in the brain. They’re also using mobile devices and “smart” wearable sensors to measure changes in respiration, temperature, heart rate, and skin responses when people are experiencing or creating art. These new portable technologies enable us to capture more accurate information as humans engage with the world in real time.

With the field at a true inflection point, we at the International Arts + Mind Lab (IAM Lab) and our colleagues are expanding the definition of neuroaesthetics to embrace not just the human response to the arts but also its broader implications for and applications to society. This translational approach brings together a range of disciplines—neuroscience, neurology, cognitive science, engineering, psychology, psychiatry, public health, design, education, the humanities, and the arts themselves—to examine the evidence and develop arts-based solutions that address real-world problems.

Despite great medical and scientific advances, there are many intractable issues in health and wellbeing around the world—and they are growing. Neurodegenerative diseases like Alzheimer's and Parkinson's and mental health disorders, depression in particular, are creating a strain on public health systems.

What if we could incorporate interventions outside traditional medicine—interventions that are engaging, empowering, affordable, and humanizing—to address these growing threats to public health?

The field of neuroaesthetics offers research-based evidence that a variety of arts-based approaches may work to improve quality of life, mobility, mental health, speech, memory, pain, learning, and more. Such interventions could potentially lower the cost and burden of chronic disease, neurological disorders, and mental health issues for millions of people.

A Neuroaesthetics Movement: Research-to-Practice Initiatives

A number of pioneering research-to-practice initiatives have launched in the US and around the world, paving the way for a shift from theory to impact.

Nearly two decades ago, clinicians and staff members at the University of Florida (UF) Health Shands Hospital proposed something revolutionary for patient care. Based on personal experience using arts to address their own stress and burnout, they started introducing therapeutic arts to [transform the hospital experience](#).

What began with practitioners' personal insight developed into a rigorous academic and clinical program for the arts in medicine. For example, UF Health Shands Arts in Medicine is home to 19 artists-in-residence and four creative arts therapists offering [bedside programming](#) and patient workshops in the visual, literary, and performing arts.

Research underpins clinical arts programming at UF. The university's Center for Arts in Medicine, home to a [research lab](#) with a staff of 30 faculty members, paid staff, and graduate students, runs several studies at any given time. Current projects include a randomized double-blind trial of [Music in Emergency and Trauma Medicine](#). This study has produced promising data suggesting the value of providing a preferential music intervention for stress and pain reduction. It also includes a qualitative arm that [outlines best practices](#) for using music in trauma care.

Enjoying music to alleviate stress is not a new idea. But offering music in high-stress settings such as emergency and trauma departments has enormous implications for healthcare. What if this simple intervention could reduce stress such that the patient is in the best possible position to receive necessary medical treatment and make a full recovery? What if music could help alleviate perceived pain and reduce the need for prescription painkillers and addictive opioids?

More recently, increasing numbers of doctors in Canada and the United Kingdom have joined the movement, prescribing [museum visits](#) and [arts activities](#) for their patients, linking patients to community resources to increase health and well-being. Similar research-to-practice initiatives have also launched in the US and around the world, paving the way for a shift from theory to impact.

The benefits to patients' health are the primary object of these initiatives, but there is a potential economic upside as well. If shown to be effective, arts interventions like music therapy could bring down the cost of treating patients to get them back on the road to health more quickly. The UF Center of Arts in Medicine is one of the institutional pioneers examining the evidence in a systematic way to define the value proposition of the arts in medicine around the world.

Healing Help for Soldiers and Veterans

For many military service members returning from overseas deployments, the joyful reunions we see on the news are just the first step in a difficult journey of adjusting to life at home after the traumas of war. The incidence of traumatic brain injury (TBI), post-traumatic stress disorder (PTSD), and depression are on the rise in the military. And such invisible wounds are difficult for service members and loved ones to understand and address on their own.

[Creative Forces: NEA Military Healing Arts Network](#) is a partnership of the National Endowment for the Arts (NEA), the Department of Defense, and the Department of Veterans Affairs that includes creative arts therapists in a team approach to help heal service members and veterans dealing with combat trauma. They receive a daily dose of art therapy through writing, music, or art-making, alongside conventional medical treatment.

Through advances in technology and imaging, researchers now know that trauma can disrupt the speech-language region of the brain (Broca's area), making it difficult for those with PTSD to verbalize and process their experiences. Therapists use art-making as one non-verbal alternative to help people exposed to trauma. In a popular [TED Talk](#), Melissa Walker, art therapist and researcher at the National Intrepid Center of Excellence, explains how art-making helps service members access pre-language areas of the brain through the use of symbols. A [mask-making project](#) enables participants to unlock traumatic experiences, turning private nightmares and painful memories into something that can be shared and, hopefully, released.

Creative Forces has invested heavily in [biomedical and behavioral research](#), investigating the effectiveness of creative arts therapies for the military, veterans, family, and caregivers. Clinical research has already indicated that art therapy can have a meaningful impact on the recovery process from PTSD and TBI. It helps those affected verbally to

process and make meaning from their experiences. On a clinical level, it aids healing by reducing symptoms such as flashbacks, nightmares, and interrupted sleep, and increasing tolerance of hyper-vigilance, pain, and stress. Art therapy has been shown to channel aggressive behavior and anger into healthy forms of self-expression. And perhaps most importantly, it gives patients a way to connect with others, reducing the overwhelming sense of isolation and stigma service members can feel when facing the invisible wounds of war.

The military's investment in and commitment to this research is significant. The Creative Forces partners understand that trauma is not limited to our service members. The discovery of cost-effective, scalable arts-based interventions is critical to the overall health and wellbeing of our country.

Dance for Parkinson's

Parkinson's disease (PD) is a devastating neurodegenerative disorder affecting an estimated [ten million people worldwide](#). It causes a host of movement-related symptoms, including tremors, muscle rigidity, slowness, and postural instability. Patients often describe challenges with everyday tasks that require fine motor control, such as writing and buttoning clothing. As the disease progresses, patients may develop a slow, shuffling gait and experience balance problems. As their mobility decreases, patients lose their autonomy and self-confidence and suffer cognitive and mood problems, all of which severely impact their overall quality of life.

Programs like [Dance for PD](#) are designed to combat both physical and mental sides of the disorder through creativity, social interaction, and "voluntary" movement (intentional), cued by music to activate specific brain regions. In 2001, Olie Westheimer, the founder and executive director of the Brooklyn Parkinson Group approached the internationally-acclaimed Mark Morris Dance Group, proposing the idea of a rigorous, creative dance class for her members. Westheimer knew from her own dance background that professional dancers developed cognitive strategies to execute difficult movements with power and grace and wanted to bestow some of that wisdom upon people with PD.

What started as monthly classes for about six people in Brooklyn has evolved into Dance for PD classes in more than 250 communities in 25 countries around the world. The program's teaching practice is underpinned by evidence from [38 peer-reviewed studies](#) indicating its possible benefits. Through Parkinson's Quality of Life measurements, class participants with Parkinson's disease reported physical, emotional and social benefits. Early research shows improvements in motor and cognitive function as well as mood, but more research is needed.

Playful Learning Landscapes

In the US, children from under-resourced communities enter formal schooling well behind the starting line. They lag behind their peers in language development, reading readiness, and spatial skills, and these deficits can persist throughout life. While education has traditionally been considered the great equalizer in helping to close developmental gaps, the reality is that children only spend 20 percent of their waking hours in school.

A multi-institutional initiative, [Playful Learning Landscapes](#), is bringing together scientists, urban planners, architects, and educators with the goal of maximizing the other 80 percent of children's time through creative placemaking, a design practice that infuses arts and culture into community spaces to effect social change. Projects transform everyday experiences—at the supermarket, the bus stop, on sidewalks, and in neighborhood parks—into fun learning opportunities.

In the Supermarket Speak project, colorful and engaging signage was posted throughout supermarkets in low-to-middle income neighborhoods to encourage caregiver-child interactions, capitalizing on organic opportunities to practice skills like counting and learning the names of fruits and vegetables. [Pilot research](#) showed a 33 percent increase in caregiver-child communication, interactions critically important to language learning and school readiness.

Another ongoing project, Urban Thinkscape, brings the benefits of playful learning to neighborhood spaces like bus stops and abandoned lots. For example, designs of bus shelters include puzzles that stimulate spatial skills; movable bench parts become opportunities for exploring language, color, and numbers; and on-site signage connects families to information and resources about the links between play and learning.

In the [“The Power of Play: A Pediatric Role in Enhancing Development in Young Children”](#) published in the journal of *The American Academy of Pediatrics*, Michael Yogman, Jeffery Hutchinson, Kathy Hirsh Pasek, Roberta Golinkoff and colleagues underscore the critical importance of play in the development of a child's executive function and social skills — essential markers of school readiness beyond reading, writing and arithmetic. “Play is not frivolous: it enhances brain structure and function and promotes executive function (ie, the process of learning, rather than the content), which allow us to pursue goals and ignore distractions.”

The authors go on to acknowledge that “An increasing societal focus on academic readiness (promulgated by the No Child Left Behind Act of 2001) has led to a focus on structured activities that are designed to promote academic results as early as preschool, with a corresponding decrease in playful learning.”

Learning Landscapes aims to reverse this trend. Based on the success of its work to date, Learning Landscapes is now collaborating with organizations, communities, and cities around the world to create more playful learning environments for children and families.

So, What's Limiting the Use of the Arts?

As the body of evidence grows, the value of the arts is becoming more obvious, and important institutions in the military, medicine, and government are taking note. But while we know the use of the arts in healthcare and education is making us healthier, happier, and smarter, and improving our quality of life, funding and support for arts education are dwindling here and abroad. What's keeping us from realizing the full potential of the arts?

To begin with, there is the pervasive belief that the arts are either a mere frill compared to the hard sciences (STEM) or a hobby reserved for leisure time. This stigma makes research funding a consistent challenge.

Foundations and private philanthropy have stepped up and supported important foundational work. The NEA has also been a staunch advocate, making key investments in the arts for health and education. But NEA resources are limited compared to the National Institutes of Health (NIH), the National Institutes for Mental Health, the National Science Foundation and the National Institute on Aging. In 2018, NIH Director Francis Collins expanded the scope of the [Sound Health initiative](#), committing \$5 million to fund [research exploring music interventions](#) for brain diseases and human health. This commitment is a promising beginning. To combat misperceptions and secure critical funding, we need more robust and better-organized evidence to demonstrate the impact of the arts.

To date, the diverse group of neuroscientists, social scientists, clinicians, artists, architects, and educators interested in the field of neuroaesthetics have largely operated in isolation. The result is few high-quality data sets, standardized measures, or broad dissemination of insights. While this is changing, we need to build a community of researchers and practitioners who are consistently studying the role of the arts and aesthetic experiences to address complex issues.

Without a unified research framework to collect and examine the biological and behavioral outcomes of arts experiences, the field will continue to struggle to make an evidence-based case for the impact of the arts. Such a consensus is essential to communicating insights and implications to policy makers and funders.

To move forward collectively, the International Arts + Mind Lab (IAM Lab)—part of the Brain Science Institute at Johns Hopkins University School of Medicine—has developed [Impact Thinking](#), a translational approach that applies rigorous, evidence-based brain science research methods to arts, architecture, and music interventions. Impact Thinking begins by engaging a broad and multi-disciplinary team in problem identification workshops and a collaborative discovery process, and finishes strong with dissemination, scaling, and impact evaluation strategies.

Using this approach as an organizing principle, we can facilitate much-needed collaboration among researchers and practitioners and build a pipeline of evidence for applied neuroaesthetics. We are already filling the pipeline through exciting research collaborations ranging from guitar lessons for PD patients to sensory care rooms for children with neurological disorders.

There's also the question of training and professionalization within the field of neuroaesthetics, which is challenging given its highly interdisciplinary nature. While there are a number of programs offering certificates or advanced degrees for Arts in Health, no such programs exist for neuroaesthetics. We are currently surveying the state of the field to identify the gaps in training that need to be filled in order to accelerate the use of the arts.

The Power of the Arts

The power of the arts has always been with us, but deeper understanding of its impact on the brain is relatively new. Research now makes clear that experiencing or creating art sparks a dynamic interplay among brain cells that spearheads billions of changes affecting our thoughts, emotions, and actions. This knowledge elevates the arts to a superpower in its potential for healing and empowerment. Indeed, if we were to design a tool from scratch to improve learning, health, and overall well-being, it would look like the arts.

As we understand more about how our brains work are sculpted through creative expression and aesthetic experiences, we find ourselves at an extraordinary moment in history. Scientific discoveries are shining a spotlight on the biological roots of the arts and uncovering a treasure trove of untapped resources to affect the human experience. We are in the age of integration where the strands of arts, sciences, and technology are coming together to create stronger solutions to complex problems.

Neuroaesthetics is on the verge of a quantum leap forward, redefining 21st-century problem-solving with medical research and new knowledge. Through its lens, cutting-edge interdisciplinary research is addressing some of the most difficult issues of our time, including chronic stress and associated illnesses, pain management and addiction, learning differences, depression and mental illness, and reduced productivity and innovation. Its potential benefits transcend class, gender, age, race, and culture, making the arts a superpower for all.

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