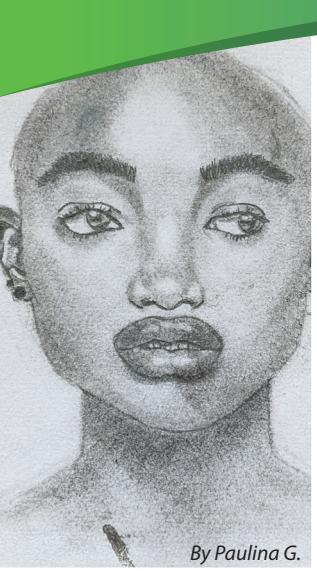
THE MAGAZINE OF THE INTERNATIONAL CHILD ART FOUNDATION

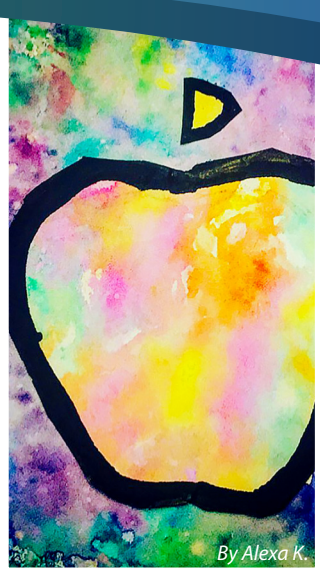
OCTOBER – DECEMBER 2020

ChildArt


By Paulina G.


By Huxley S.


By Alexandria J.

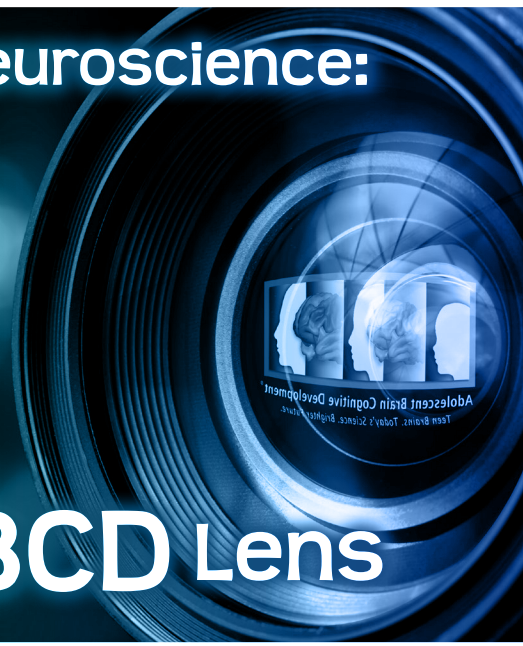

By Alexa K.


By Natalie W.

The Intersection of Art and Neuroscience:

Adolescent Brain Cognitive Development®

Teen Brains. Today's Science. Brighter Future.



A View Through the ABCD Lens


By Aaron G.


By Viviana V.


By Cameron T.


By Defne Y.


By Paula C.

From the Editor

[I]t never ceases to amaze me that all the richness of our mental life—all our feelings, our emotions, our thoughts, our ambitions, our love life, our religious sentiments and even what each of us regards as his own intimate private self—is simply the activity of these little specks of jelly in your heads, in your brains. There is nothing else.

— V. S. Ramachandran

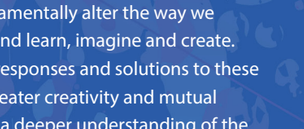
Today we face the uncertainties and suffering caused by Covid-19. Soon, advances in artificial intelligence, automation, and robotics will bring about what we call the fourth industrial revolution, which will blend our physical, digital, and biological worlds. This will fundamentally alter the way we live and work, think and learn, imagine and create. Socially appropriate responses and solutions to these challenges require greater creativity and mutual empathy. This makes a deeper understanding of the human brain imperative.

We are delighted that the National Institutes of Health is funding a $400 million research project on the brain and human development, involving nearly 12,000 schoolchildren over ten years. Within the pages of this issue of ChildArt you will get a first look at what researchers are learning, what questions continue to be explored, and what contributes to brain health.

We are most grateful to the NIH for partnering with us to bring to you this special issue of ChildArt to highlight the Adolescent Brain Cognitive Development℠ (ABCD) Study and the intersection of the arts and neuroscience.

We thank the ABCD Study® families, researchers, and staff for their contributions; the scientists and artists that share our enthusiasm for the arts through their contributions; and Dr. Katia Delrahim Howlett for putting this special issue together as Guest Editor.

You will enjoy learning something new about yourself and others because one thing we all share is the human brain.



Ashfaq Ishaq, Ph.D.

From the Guest Editor

It is an honor to serve as guest editor of the Adolescent Brain Cognitive Development (ABCD) Study Issue of *ChildArt*. When we began this journey in winter 2019, I had a vision that we could bring the science of the ABCD Study to life through the artistic lens of the researchers, families, and our partners. I am humbled to see this vision realized via the contributions and enthusiasm from colleagues at the International Child Art Foundation (ICAF), the National Endowment for the Arts, the National Institute on Drug Abuse, and many others.

This issue of *ChildArt* introduces the reader to the ABCD Study, the intersection of art and neuroscience, and the potential impact of the arts on health and well-being. The ABCD Study has promise to bridge many different areas of science and yield discoveries beyond what we had originally imagined. With each year and each data release, we are introduced to the opportunities this study opens for the research community toward something greater and more impactful. This issue begins to demonstrate the power of science and the power of art—and when combined, this force can instill hope, understanding, and meaning.

Science and art have in common intense seeing, the wide-eyed observing that generates empirical information.

—Edward Tufte

To Ashfaq Ishaq and Katty Guerami at ICAF, thank you for entrusting our team—we are grateful for your collegiality and for continuously recognizing the power of the arts for the well-being of children. To Sunil Iyengar at the National Endowment for the Arts, thank you for joining us as we explored and mastered this inaugural and successful collaboration. To Mehron Zadeh at Connect Contemporary, Inc., thank you for answering my call for help and connecting us with Craig Alan and Srinjoy Gangopadhyay—whose artistic journeys are inspiring and empowering. To Eric Wargo (Assistant Guest Editor) and Oslo (Designer Extraordinaire): thank you; without your technical and creative "magic" this issue would not have come together as beautifully as it did. To the many authors and artistic contributors—thank you for your patience; this would not have been possible without your dedication to the ABCD Study and the value of the arts in development.

And to you, the reader, I hope you enjoy, discover, and create...the opportunities are endless.

Katia Delrahim Howlett, Ph.D., M.P.P., M.B.A.

Deputy Director, Division of Extramural Research
National Institute on Drug Abuse, NIH

Learn more about the developing teen brain and get answers to your questions about drugs and your body at teens.drugabuse.gov/childart.

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Science and Art Come Together in the National Institutes of Health's ABCD Study

Art is one of the most basic, and oldest, human activities. Forty thousand years ago, humans living in what is now southern Germany carved human and imaginative human-animal figurines from mammoths' ivory. They painstakingly fashioned flutes from the bones of eagles, so we know they played and enjoyed music. Meanwhile, humans in France painted realistic horses, bison, and lions on the walls of caves—paintings that the famous Spanish artist Pablo Picasso thought were unsurpassed by any paintings made since then.

Art defines us as a species—no other animal makes pictures or sculptures or music as we know it, even our closest primate relatives, chimpanzees and bonobos.*[1] Our ability to imagine and make symbols is unique, and it starts when we're very young children. When a toddler creatively transforms a spoon into an airplane or a box into a house, these are early symbols; they'll use many others throughout their life to communicate, understand, and manage their physical and social world. Imagination is play with a purpose; it plays a crucial behind-the-scenes role in our ability to think.

Art is not only something we do; it is something we need. It's the most basic form of culture—the complex systems of symbols we share with other people. Culture allows us to coordinate our activities with others and cooperate with them. Humans are social creatures; we're totally dependent on interaction with others. We communicate our feelings and intentions to them with the symbols of language—letters and words. But we also communicate with our bodies, and with pictures and objects and songs. Thus, we are able to express our inner experience. Art creates a special kind of social interaction between the person who creates an artwork and the person who receives it.

"Childhood Landscape" by Nora Volkow

The feeling of awe and mystical connection that art can produce is a humanizing force. When we listen to a piece of music, admire a painting, or read a novel, we're interacting with the mind of the person who created it, via the sensations and the emotions in our body that the work elicits. Through experiencing art, we have special access to the experiences of other human beings, even ones whose lives may be very different from ours or who lived in other times in history. In this way, it activates our imagination and enables us to empathize while expanding our experience. Society, culture, and civility—cooperation with our fellow humans—would be unthinkable without art.

Nora D. Volkow, M.D.
Director, National Institute on Drug Abuse
National Institutes of Health

*Bowerbirds in Australia and New Guinea construct house installations to attract a mate. Some of these are quite beautiful and are considered by some people to be artistic creations, although they are constrained by their unique purpose. This is different from the "open" purpose of human art.

[1] https://www.discovermagazine.com/planet-earth/how-closely-related-are-humans-to-apes and https://www.sciencemag.org/news/2012/06/bonobos-join-chimps-closest-human-relatives#:~:text=Ever%20since%20researchers%20sequenced%20the,them%20our%20closest%20living%20relatives

[2] https://www.famousscientists.org/santiago-ramon-y-cajal/

And now we know that art also heals. Listening to music, for example, produces changes in the brain and body that can reduce stress and promote psychological well-being, which in turn has a beneficial impact on physical health. Making music or drawing or creating art in other ways also has health benefits. Performing with or for other people can connect us directly, but even creating or enjoying art on our own can be healing. It may be that some of the therapeutic benefits of appreciating and making art come from how it enhances our feeling of human connection and belonging even in solitude.

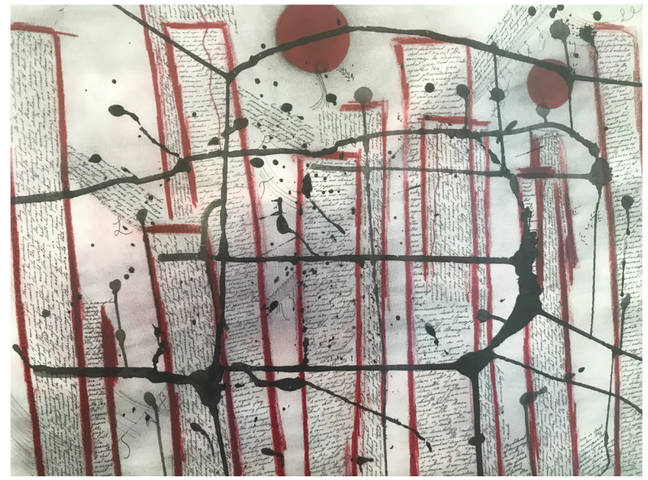
Art and Science

In my work life, I'm a scientist who studies the brain. But in my spare time, I'm a painter. I like to create imaginary landscapes, such as "Childhood Landscape" (left) and "City Landscape" (right).

Science and art are similar in many ways. Both an artist and a scientist must be able to think creatively, to find hidden associations, and to imagine new solutions to problems. Then, they both have to figure out the most elegant way to experiment and test their solutions. An artwork can feel like an experiment—it might attempt to uncover a hidden perspective, create a new association, or investigate a complex feeling.

When I paint, I allow unseen shapes to guide the contours of the colors and forms in ways that feel right to me emotionally. Above are two paintings that show how I uncover feelings and perceptions by allowing these shapes to emerge. The painting at the left is my rendering of a huge yellow wall in the house I grew up in. As a child, I enjoyed looking at that wall. The paint was peeling and the color in some places had been changed by the rain; I could see a variety of creatures lurking in those flaws.

The painting at the right is inspired by the landscapes of



"City Landscape" by Nora Volkow

New York City at night. I enjoyed looking at the windows and seeing people interacting with one another in words I couldn't hear. Yet we were connected, because we were all experiencing the same moment in time.

Butterflies of the Soul

In other ways, however, art and science are very different from each other. Science is a collective effort that proceeds cautiously in investigating problems, while art can be very personal and playful. In science, the aim is to explore and understand reality, while art can create a completely new reality. The artist has the freedom to explore and understand the world in a new way. Those new ways of understanding can then inspire the scientist to observe the world differently, too.

Some people are both scientists and artists, including in my own field of neuroscience, the study of the brain and nervous system. Almost 150 years ago, a pathologist in Spain named Santiago Ramon y Cajal[2] observed unique cells in tissues from animal brains under a microscope. He was the first to describe the tree-like shape of nerve cells (or neurons) and the amazingly complex ways they connect with each other. To share his discoveries, he made exquisite ink drawings of neurons, allowing other people to see for the first time the sublimity of the brain at the cellular level. Today, his drawings are also recognized as works of art.

Ramon y Cajal didn't yet know exactly how neurons worked or communicated with each other. But what he saw through his microscope enabled him to sense what neuroscientists now take for granted: that these amazingly complex structures are the very basis of everyone's

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Understanding Your Amazing Brain: The Promise of the ABCD Study

The human brain is the most complex organ in the body. It's made up of eighty-five billion nerve cells, or neurons. Neurons in the brain connect to each other, creating a complex network that allows people to make art, feel emotion, and solve problems. Every one of us has a unique brain network that makes us who we are.

When you're born, you have a different brain than you'll have as an adult. A baby's brain starts out with at least 100 billion neurons. By age three, your brain has approximately one quadrillion connections called "synapses"—many more than you need. As you grow and your brain develops, some synapses get stronger, but many others are gradually lost. This is normal! By the time you're twelve years old, your brain has reached its full physical size—but, as you have new experiences as a teen and young adult, your brain connections continue to be refined well into your twenties.

We know all this, and much more, thanks to neuroscience—the study of the nervous system, which includes your brain. But there's still a lot to figure out, especially about the developing brain in children and teens. That's because new experiences influence how the brain develops. And kids and teens have a lot of new experiences! Whether those experiences are exciting, baffling, overwhelming, or frightening, they shape who you are and who you'll become—usually without you even realizing it.

A look into the growing brain

How exactly do these changes happen in the brain? Scientists and researchers at the National Institutes of Health (NIH) are trying to answer this question and many others. The NIH—the government agency that supports research about the body and behavior—funded researchers in the fields of adolescent development, psychology, and neuroscience to launch the Adolescent Brain Cognitive Development Study (ABCD Study).

Starting in 2016, ABCD Study researchers enrolled nearly 12,000 kids ages nine and ten. For ten years, researchers will work with these youth to understand the different influences that affect their brain development and their general health. Researchers will use magnetic resonance imaging (MRI; see box) to study the kids' brain structure and function, and their biological and behavioral development.

Researchers use questionnaires to ask youth about their physical and mental health; their experiences with sports, art and music classes, and any drug use; and their family, school, and neighborhood environments, among other things.

Researchers will also ask them to play certain games to measure their brain and cognitive function and will collect biospecimens (such as blood, saliva, etc.) to examine the effects of genetics, puberty, and exposure to things such as heavy metals (lead, for example) and drugs of abuse on brain development. The researchers will continue to monitor these areas every year or two until the youth are nineteen and twenty years old.

The Promise of the ABCD Study

The youth participating in the ABCD Study are as diverse as the United States. Approximately half are female, 15 percent are Black, 20 percent are Hispanic, and 52 percent are white. Participants come from seventeen different states, from big cities and small towns, and from different economic backgrounds. A large and diverse study like this makes it possible to investigate what contributes to normal differences in brain development, to understand what puts some people at risk for health problems, and to learn what makes some people able to recover from difficult experiences more easily than other people do.

In March 2020, all of our lives changed dramatically because of the coronavirus called COVID-19. This gave the ABCD Study researchers an unexpected opportunity to learn how kids' and teens' experiences related to the COVID-19 pandemic affect them now and in the future. Because the COVID-19 situation is always changing, the researchers are asking the ABCD Study participants and families questions about these experiences every month.

In the four years since the ABCD Study began, researchers have already started to understand more about how certain traits and experiences (such as sleep, art and music education, family conflict, and screen time) relate to brain differences and other outcomes like the ability to learn and understand new information, and problems with mental health. [To learn about one of these findings, check out the article in this issue titled, "Music's Harmony on the Developing Brain: Data From the ABCD Study."]

So far, most of these studies have only looked at these things at a single point in time. But because the ABCD Study is collecting data over many years, researchers will be able to examine how these experiences change the brain as people grow up. By helping us examine and understand the amazingly complex brain, the ABCD Study may help future generations of teens to live better, healthier lives.

By Gayathri J. Dowling, Ph.D.
Director, Adolescent Brain Cognitive Development Study
Division of Extramural Research
National Institute on Drug Abuse
National Institutes of Health

What is MRI?

MRI, short for **magnetic resonance imaging,** is a procedure that uses magnets to take three-dimensional (3D) pictures of the body. MRI scans do not use radiation or x-rays, and they're safe and painless. Researchers in the ABCD Study use MRI to collect 3D images of the brain. Some of the MRI scans in the ABCD Study collect pictures of the brain that show details about its physical structures. Another type of MRI, called functional MRI (fMRI), lets researchers see which parts of the brain are active while a person plays a game or does a task.

The MRI scanner is about the size of a play tunnel. Once a person is inside, the researcher checks to make sure the person feels as comfortable as possible. Then the researcher moves to a room nearby to take the pictures. During the scans, the person must lie perfectly still so the machine can collect very clear images of their brain. The MRI scanner makes a lot of noise, which is caused by vibrating metal coils inside the machine. It can sound like a foghorn! Many people wear earbuds and headphones to block out the sound.

How does MRI see the brain so well?

A computer program uses the MRI pictures of the brain to create high-definition 3D images. The images show the physical structures in the brain from top to bottom and from side to side. Pictures from an fMRI can show what the brain looks like while a person is thinking about something like a funny joke or a difficult math problem, or while playing a game. When part of the brain is working hard, it needs more oxygen, just like your lungs need more oxygen when they're working hard. **fMRI lets scientists see when a part of the brain is using more or less oxygen.** For example, when you do a math problem, more oxygen flows to the parts of your brain that are working to solve the problem. If you do this while having an fMRI, scientists can see your brain "in action." So, fMRI helps scientists see which parts of the brain are important for thinking about different things.

Art by Gaya Dowling

Your Adolescent Brain: It's a Construction Zone

During adolescence, as you become adults, a lot of changes take place in your body. But defining exactly what "adolescence" is, and when it occurs, isn't as easy as it may seem. We do know that, in general, adolescence begins in puberty; this happens for girls between the ages of nine and ten, and one to two years later for boys. The hormones associated with puberty cause changes in the body that lead to physical sexual maturity. But it isn't clear when adolescence ends—or, in other words, when bodies reach their adult form.

Adolescence is a very busy time, both inside and out. An adolescent's behavior, thinking, and emotional control are changing at the same time that social expectations are rapidly changing for them. This is all part of the normal process of becoming an adult. As children navigate from elementary school into middle and high school, they begin to become independent from their family; this is especially important during adolescence, as teens prepare for adulthood. But when does "adolescence" end and "adulthood" begin in the brain?

The adolescent brain is like a construction zone. Physical maturity can be observed on the outside, but what defines "adulthood" may be related more to what's going on between an adolescent's ears. Scientists have learned a lot in the last few decades about how the brain typically develops during childhood and adolescence. They do this by using tools like magnetic resonance imaging (MRI), which can open a window into a teen's head (without opening their skull!). We've learned that the brain structure tends to grow or mature from the back to the front, and from the bottom to the top. The regions of the brain that mature last include the frontal lobes. These are responsible for what we call "executive functioning"; they're kind of like the brain's "boss." Development of the frontal lobes allows for better control over the parts of the brain that are responsible for your emotions, your actions/behavior, how you process risks and rewards, and how you make decisions, among other things.

Let's look at an example. Picture a preschool child whose needs and desires aren't being met. For this child, the obvious answer may be to have a tantrum, or just to take the object they want from another child (likely leading to more tantrums). By the time this child has reached age ten or twelve, they've probably learned through experience that there are better ways to get what they need or want, like using words and conversation. Their frontal lobes are "coming online" and controlling their brain's emotional regions, so their social interactions are appropriate for their age. This brain maturation (the process of becoming mature) continues until a person is in their mid-twenties. A sixteen-year-old may think it's a good idea to drive a car as fast as she can to get to a pool party; when she's twenty or twenty-five (after a few speeding tickets, or worse), she might be better able to hold herself back and reduce the risks that go with getting what she wants as quickly as possible. These are the frontal lobes in action.

But what, exactly, is the brain "doing" to make this maturation happen? Scientists are beginning to find out. We've learned that the brain produces far more brain cells (called neurons) and connections between its different systems than it needs later to process information, thoughts, and behavior in adulthood. Over time, as the brain has more experiences in a teen's social and physical environment, it "prunes" away the connections it doesn't use anymore—like cutting dead roses from a bush. At the same time, connections that are essential for achieving today's and tomorrow's goals become more "hard wired," so they work more quickly. The brain maturation process is like building a freeway between two cities for faster travel, instead of relying on unpaved back roads.

This makes sense when you think of the brain as using a limited supply of energy to keep all of a person's "lights on" all the time. Energy that supports brain connections and neurons that aren't really helping you to achieve any goals may not be worth the "cost," if there isn't enough energy left to support the new thoughts, skills, and behaviors that happen as you grow up. The kinds of energy and connections your brain needs to learn a new skill, like talking or reading, may not be needed anymore after it masters those skills. Once the energy is used to connect visual symbols (letters) into meaningful words and phrases, the energy for those brain regions may be better spent on new skills like learning algebra, how to play a musical instrument, how to draw, or how to drive.

So, we're getting closer to an answer for the question of when adolescence ends and adulthood begins. We're learning more from studies like the Adolescent Brain Cognitive Development Study (ABCD Study), which is examining how the brain, thoughts, and behaviors develop in diverse children and adolescents from ages nine to about twenty. Eventually, we'll understand better how every experience a person has—in their brain and their outside environment—helps to shape them for adulthood.

Art by Elizabeth Sowell

By Elizabeth Sowell, Ph.D.
ABCD Study Principal Investigator
Children's Hospital Los Angeles
Professor of Pediatrics
Keck School of Medicine of University of Southern California

Art by Cricket L.

ART + SCIENCE = POWER

How has art helped you during this COVID-19 time?

Art relaxes me; it helps me take my mind off things and allows me to re-center myself. It's gratifying to start with an image in my mind and develop it as different components come to me while I'm working.

Art also helps me see the world differently. For instance, when looking at a landscape (in real life, a photograph, or a painting), I can identify the three "grounds": foreground, middle ground, and background. This allows me to appreciate everything I see around me much more deeply.

—Emma C.

What types of art do you see in nature?

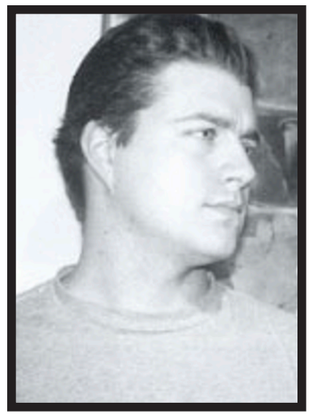
I see art in nature. Sometimes I see it in a leaf that looks like it's been painted. Sometimes it's the way a squirrel moves. I think water is very much like a dance—water reflects trees and plants, but also flowers, and sometimes dances are supposed to look like flowers. Water moves. The way it moves looks like a dance. The sky, that's another brilliant piece of art. I love the way clouds move, but my favorite part about the sky is that in sunrise and sunset the sky changes colors. I like to paint nature landscapes because trees look very different from each other; mountains too. Also, there are many colors in a natural landscape. That's what makes them so fun to paint.

—Michelle C.

Art by Aaron G.

THE POWER OF ART

CRAIG ALAN'S STORY IS ***INSPIRING*** FOR KIDS WHO, LIKE HIM, ***ENJOY*** CREATING NEW THINGS. IT MIGHT ALSO ***HOLD A LESSON*** FOR PARENTS WHO MAY NOT RECOGNIZE THE ARTISTRY AND IMAGINATION IN THEIR KIDS' CRAYON WALL ART. WHO KNOWS ***WHERE*** IT COULD ***LEAD THEM?***



Artist Profile:

Craig Alan

As far back as he can remember, Craig Alan has been creating. As a kid, he found an artistic outlet by drawing with crayons on his parents' walls. Craig continued to work on his art (not only on walls!) and gradually got better at it. In spite of his expressive drawings with crayons and his parents' encouragement, Craig never imagined that he would become a painter.

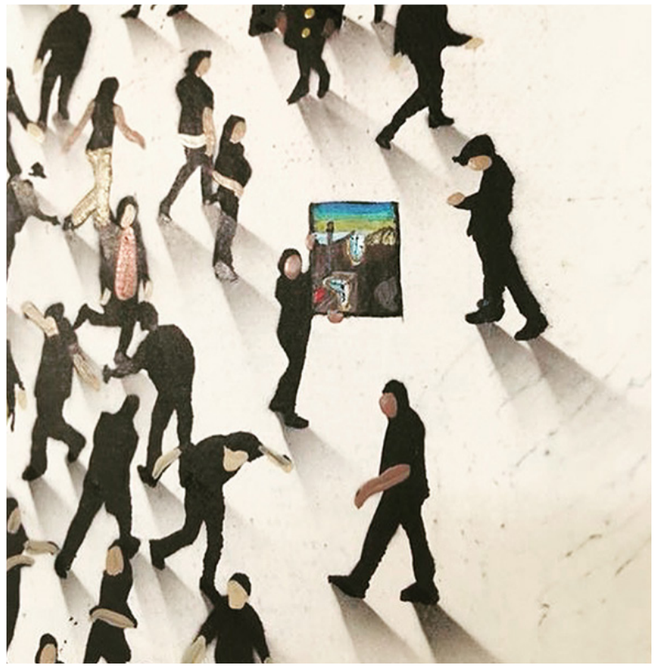
Craig went to elementary and middle school in California. He says, "I remember when I was as young as eight, our teacher would write stories, and we illustrated the stories with five drawings. We did this assignment one day a week. It was one of my favorite parts of school." His creativity blossomed throughout his childhood and early adulthood. Today, Craig Alan's art is exhibited across North America and in Europe, where he has become a one-of-a-kind voice in the visual arts.

Craig knows the power of art. "Art is incredibly important for kids, for many reasons," he says. Here are a few reasons he thinks this is true:

- ***Creating art helps you be yourself*** *and not be afraid to express yourself—even without using words or your voice.*
- ***Art can help you solve problems.*** *It's a great way to experiment and try new things. When you try art, you always answer the question, "What if?"*
- ***Getting lost in your imagination*** *can turn your ideas inside out and upside down—that's a really beautiful thing!*
- ***Art can help you tell a story*** *in your own way. There is no better way to build your confidence.*
- ***Sometimes, we can learn things more easily*** *if we have a visual or a picture to help us understand it. Artists are needed in all areas of education to help represent math, science, language arts, and history in visual ways. We can inject the creativity of art into all aspects of life and learning.*

Craig focused on soccer in college and was offered an athletic scholarship. It was stressful for him to balance college classwork, soccer, and friendships, and his grades began to suffer. To help improve his grades, Craig took an art class. His first class—pottery—had an unexpected and important benefit: It helped him make sense of everything. School became easier for Craig; he actually wanted to learn because he saw how his classwork and lessons applied to his life. "I threw myself into [art], and it ended up changing my whole perspective on learning," Craig says. He connected with a publisher and started on his path in the art world. "That's basically how I went from jock to art student to painter," he explains.

As an artist, Craig has a restless eye. His work refers to numerous artistic styles, including pop-surrealism, magic realism, neoexpressionist abstraction, and natural representation. His most recent work, which he calls the "Populus Series"—a few pieces of which are featured in this article—includes original images of hundreds of tiny people on a white background. At first glance, the paintings look like aerial photographs, but a closer inspection reveals that they're painted by hand. Craig hopes that viewers of his paintings will realize "that we are all part of something greater than ourselves, and if we work together, we could achieve greater balance…not in a religious sense, but rather a universal sense."



Connecting with STEM Through Movement and Dance

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University of Florida
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Dean's Professor
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Department of Epidemiology, Colleges of Public Health and Health Professions and Medicine

In a summer program for youth ages nine to fourteen, five students sit on the floor of a large room and work together to develop a scientific representation of the human nervous system. After they read their research notes from the day before, they stand up and hold hands in a circle. Their sketchbook and notes lay on the floor, along with a few tools and an energy stick made with lights in a plastic tube that illuminates when someone holds both ends. Their conversation becomes a mix of talk, movement, and sound effects. They move quickly around the space—running, jumping, spinning.

At first glance, this composition of sights and sounds could easily be interpreted as a chaotic and unfocused activity. Are the children playing a new kind of game? Actually, they're doing complicated work, using their minds, knowledge, imagination, and dance to represent the human nervous system—specifically, how the brain communicates with the body. They're developing a project in the "dance makerspace."

Makerspaces are "informal sites for creative production in art, science, and engineering where people of all ages blend digital and physical technologies to explore ideas, learn technical skills, and create new products."[1] "Making" activities combine engineering, art, and design.[2] The dance makerspace, however, is a little different. Like other makerspaces, it's filled with materials, tools, and technologies students can use. There are workstations with access to tablets and electricity where groups can collaborate.[3] But in the dance makerspace, participants also have a dance studio, where they develop their ideas by using movement, music, and art.

The dance makerspace was designed as part of a four-week summer camp program in Gary, Indiana, for young African American dancers. One of the program's goals is to get students interested in the fields of science, technology, engineering, and math (STEM). Research has shown that students ages nine to fourteen become much less interested in STEM, particularly girls and African American children.[4] Youth from underrepresented communities who aren't STEM learners, but are interested in dance, attend the camp five days a week. They're challenged to combine dance-making with technology, using kid-friendly electronic items (such as lights, electronic boards, and clay that conducts electricity), and a range of other tools and materials.

Education researchers study the "making" process, the products the students create, and interview the students to learn the thoughts behind their "making." This helps the researchers understand how youth make sense of new ideas, think about their old ideas, and translate their understanding through choreography, props, sound, and other ways of making. In the dance makerspace, STEM is not just STEM, movement can be more than just movement, and the pathways to learning are limitless. The students choose how they want to use their own interests to create meaningful STEM experiences. They decide how to research their own questions and construct their own creative solutions.

In the dance makerspace, STEM is not just STEM, movement can be more than just movement, and the pathways to learning are limitless.

The dance makerspace camps—designed and facilitated by Dr. Dionne Champion, a researcher at the University of Florida Center for Arts in Medicine—have taken many forms. In one series of camps, students worked in groups to explain a scientific fact or event using choreography and technology. These groups completed projects about the nervous system, the solar system, health conditions, blood flow, volcanic eruptions, and the chemistry of mood rings. Working with community arts programs to develop activities like this helps students make connections between the arts and their own physical, mental, and emotional well-being.

In a current version, youth are using hip hop art, music, and dance as part of a research project supported by the National Science Foundation. "The Hip Hop Making Camp" project aims to create a learning environment that other teachers and students can use, combining creative ways of "making," computer programs, and parts of hip hop culture. Students learn how electrical engineering is part of the history of hip hop (for example, how the crossfader was invented to switch between records). They learn about how hip hop pioneers like DJ Kool Herc created by "making do" with materials that they already had, and they're challenged to invent their own hip hop STEM creations by "making do" with materials available in the space. They learn to make computer art, and to program music with free software. They also create dances and develop rules about how the dances should be performed, then they create and program computer

Continued on page 37

Dionne Champion, Jill Sonke, and Linda Cottler

[1] *Sheridan, K., Halverson, E. R., Litts, B., Brahms, L., Jacobs-Priebe, L., & Owens, T. (2014). Learning in the making: A comparative case study of three makerspaces. Harvard Educational Review, 84(4), 505-531.*
[2] *Wagh, A., Gravel, B., Tucker-Raymond, E., & Klimczack, S. (2016, October). Negotiating tensions between aesthetics, meaning and technics as opportunities for disciplinary engagement. In Proceedings of the 6th Annual Conference on Creativity and Fabrication in Education (pp. 58-65). ACM.*
[3] *Hlubinka, M., Dougherty, D., Thomas, P., Chang, S., Hoefer, S., Alexander, I., & McGuire, D. (2013). Makerspace playbook: School edition. Retrieved from: https://makered.org/wp-content/uploads/2014/09/Makerspace-Playbook-Feb-2013.pdf.*
[4] *Haynes, L. (2008). Studying STEM: What are the barriers? London, England: Institute of Engineering and Technology.*

Music's Harmony on the Developing Brain:
Data from the ABCD Study

By Tim Brown, Ph.D.

Associate Professor of Neurosciences
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John R. Iversen, Ph.D.

Assistant Research Scientist, Institute for Neural Computation
Associate Director, Swartz Center for Computational Neuroscience
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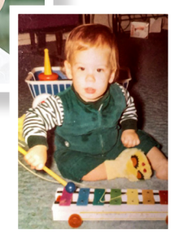
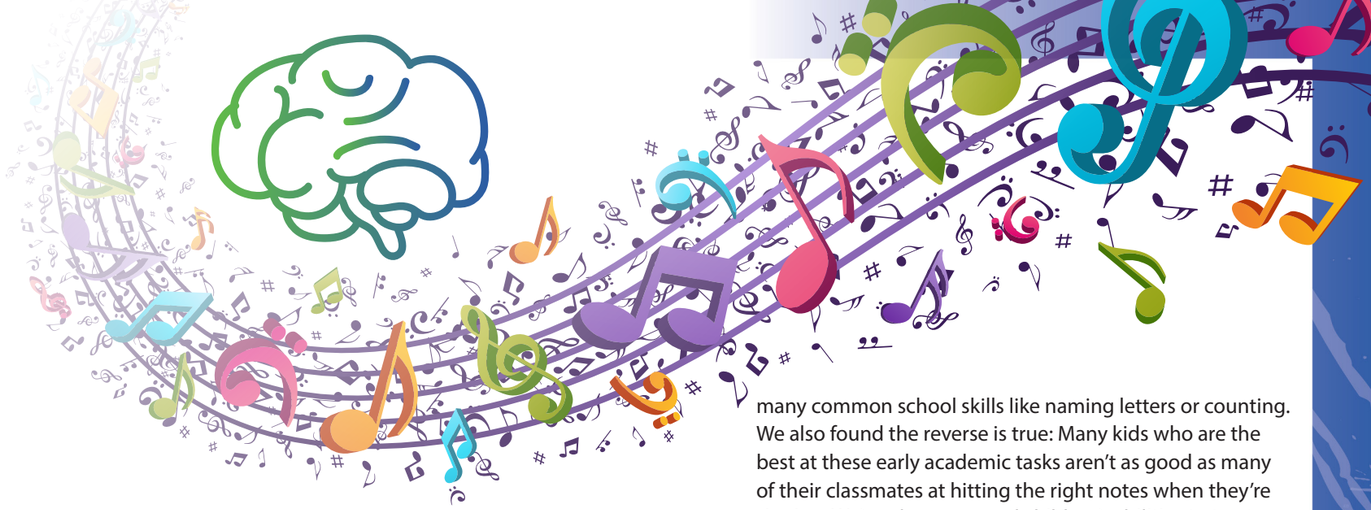


John Iversen

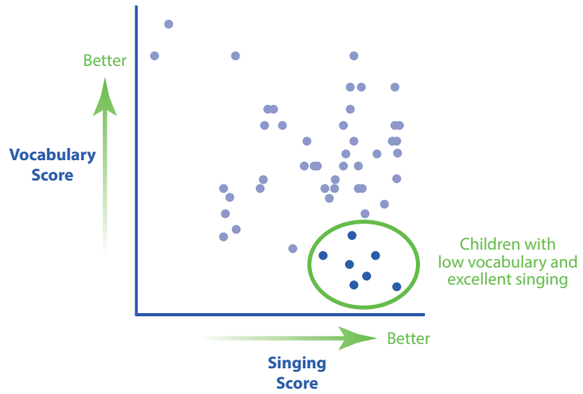


Music is an important part of human culture, and the idea that it's important for learning has been around at least since ancient times. Confucius and Socrates wrote that music training contributes to a refined mind and harmonious society. Now, researchers are looking at how music might help kids learn.

Encouraging children to reach their full potential, while celebrating individual differences, is complicated. Researchers approach this challenge in many ways—from small studies that test the effects of a particular music training program on children's abilities to think and do different tasks, to very large studies like the Adolescent Brain Cognitive Development Study (ABCD Study). The ABCD Study is examining connections between a child's experiences with music and their other abilities and outcomes.

Past research has suggested that music might improve a child's language skills and their ability to pay attention, and that kids involved in music might come to school more often and stick with school longer. But this research has raised a lot of questions, too. For example, does a child who studies how to play a musical instrument get better in school because of music … or do kids who do well in school already also do well at music, or get more chances to take lessons?

Tim Brown



Vocabulary and singing scores for students in the EARLI study (each dot is the score for one student).

Our research team has started a project called EARLI (Early Academic Readiness and Learning Intervention) to explore some of these questions. In this project, funded by the National Endowment for the Arts and private donations, we're seeing if a fun, daily program of group singing lessons—developed by an experienced teacher from the San Diego Children's Choir—helps young children do better as they enter kindergarten.

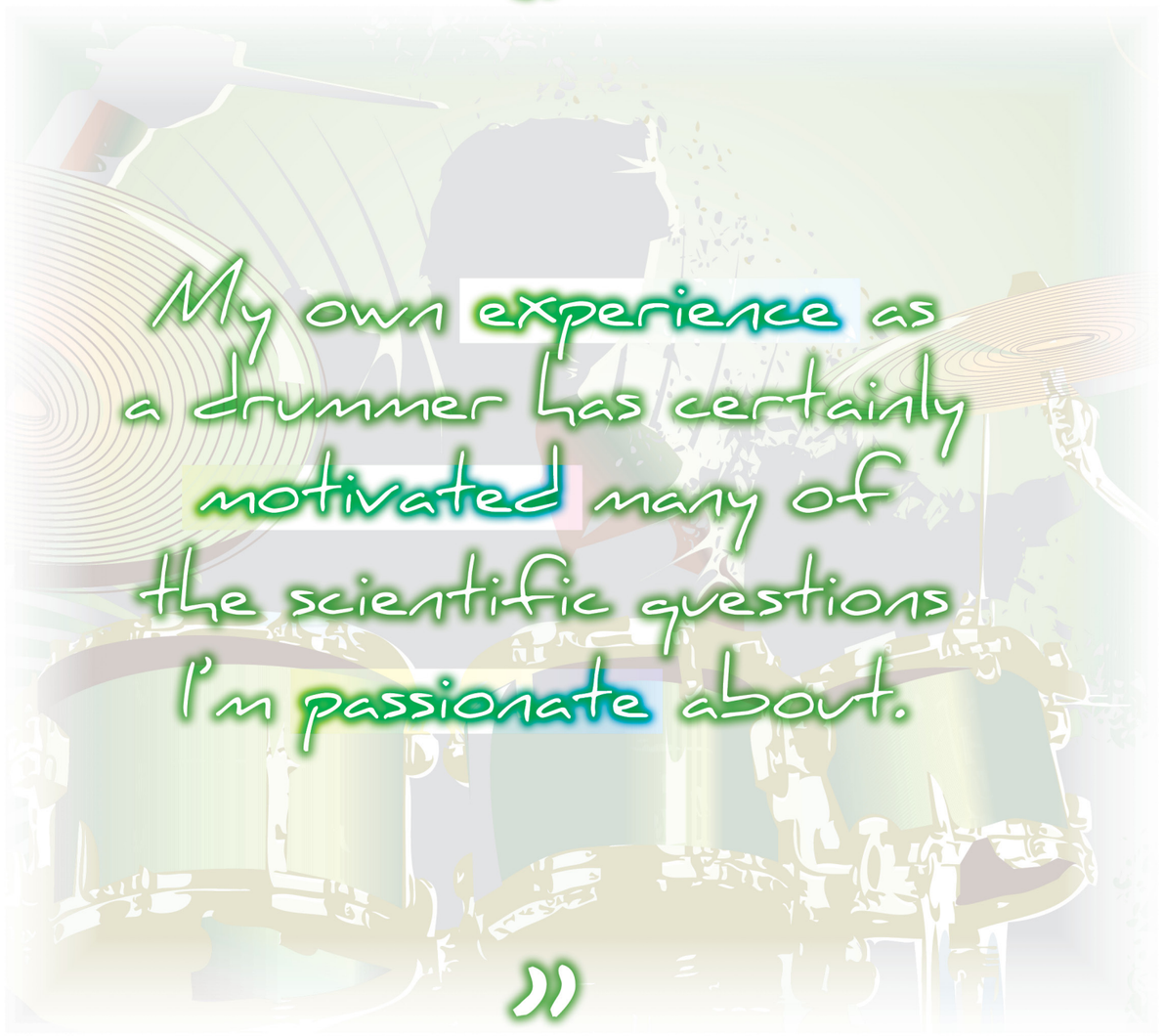
We first worked with kids to get an idea of how each one's skills were already developing in areas like language, math, attention, hearing, melody, and rhythm. Then, some of the children began taking a half hour singing lesson four times a week for two months. After that, we repeated our initial research to see if the music training changed the path of each child's development (for example, did it speed up?). It was important to check if it was really the music that had any effect, so we also worked with children who did not get the music training. We did this research in schools and involved the children's teachers, families, and school administrators, in order to get "the big picture" about the children's learning.

So far, we've focused on one question: Does a child's musical abilities match their academic skills like reading and math? Previous research has shown that children who do well on one kind of school skill, like naming letters, also tend to be good at other school skills, like counting—even though those skills may seem pretty different. Do early developing musical abilities act this way, too?

Our results suggest that they don't. Using a task that requires kids to sing the same notes they hear from a music teacher, we found that some of the very best singers at pre-kindergarten ages don't do as well as their classmates at many common school skills like naming letters or counting. We also found the reverse is true: Many kids who are the best at these early academic tasks aren't as good as many of their classmates at hitting the right notes when they're singing. We've also measured children's abilities to tap to a rhythm, which showed similar results. Taken together, what we found suggests that musical abilities at this age might develop separately from other skills that are commonly measured in school.

One lesson from this research is that musical skills can provide a new window into a child's strengths. This information could help families and teachers approach each child from a place where they're already strong to help improve other skills. To go along with our EARLI study, we're also taking a deep dive into what the ABCD Study has found out; in fact, music is the most frequently reported arts activity in the ABCD Study. With a grant funded by the National Institutes of Health, we're also exploring connections between how much music experience each child has; measures such as math performance, language, and memory; and changes in the child's brain structure over a period of time. By combining the ABCD Study's results with very detailed studies like EARLI, we're continuing to learn about how music may affect—and improve—children's health and education.

In-school singing training in a transitional kindergarten class.



John Iversen

You’re a lifelong percussionist. How did you get interested in drums? Do you still play regularly?

They say I was playing the pots and pans before I could walk. Some other fortunate things encouraged me: I had two uncles who were drummers, an elementary school with a serious instrumental music program starting in first grade, and understanding parents. It went both ways: My drum mentor fed my scientific side and turned me on to computers and electronics. I played a drum set for many years, and began Japanese Taiko drumming (a dynamic, athletic form of group drumming performance) while I was in graduate school in Boston. Later, I co-founded a Taiko group in San Diego, and it’s still going strong. Recently, I’ve returned to the drum set, jamming with a close guitarist friend (who’s also a music neuroscientist). Even when I’m not playing, I’m pretty tuned into the rhythms all around us.

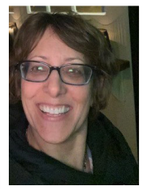
Research shows that music and rhythm can change the brain and have positive effects on mental health. Is this something you’ve noticed in your own experience as a drummer?

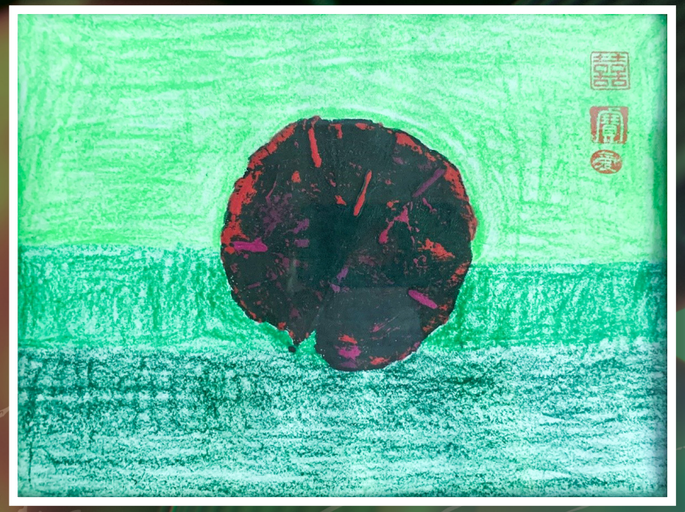
My own drumming experience has certainly motivated many of the scientific questions I’m passionate about, such as how the brain perceives and makes rhythms, and how this relates to language and attention skills. Personally, drumming has been a profoundly positive part of my life. There’s nothing like the connection of making music with other people and sharing our energy with an audience. Drumming is physical; it can require such a focus that there’s no way to hang on to negative emotions. I like to say it helped get me through grad school in one piece!

It’s pretty cool that you get to merge your interests in music and the brain. What made you decide to pursue a professional career in neuroscience rather than, say, percussion?

I couldn’t agree more! It turns out that a lot of scientists studying music and the brain, including Tim Brown, my coauthor in this issue, have a background in music. We’re very fortunate to have found a way to combine our passions. Why did I take the path I did? I realized I didn’t have the chops to be a professional drummer, and as a teenager, I reasoned that it was more possible to be a scientist with a lifelong hobby of music than the reverse. I was drawn to studying the brain by the hope that someday I’d do research relevant to people’s lives. I studied physics and then neuroscience, focusing on how the brain changes after a person loses their hearing. Only later, after I got my Ph.D., did I bring my interests in the brain and rhythms back together. The great news is that the study of music, the brain, health, and education is growing, thanks to support from the National Institutes of Health, the National Endowment for the Arts, and the National Science Foundation.

By Elizabeth Hoffman, Ph.D.
Scientific Program Manager
Adolescent Brain Cognitive Development Study
Division of Extramural Research
National Institute on Drug Abuse
National Institutes of Health





This sand dollar reminds me of my family vacations in Maine. We go to Maine every year and we are happy there and find sand dollars and enjoy the beach.

We couldn't go this year. So, I couldn't see my turtle and frogs. I miss them. I created this gyotaku art for school. And every time I look at it, I feel happy.

—Camden M.

Like so many others, the coronavirus pandemic has taken so much from me. I have been affected physically, mentally, and socially. I am tired of being home, and I wish we all could have the same amount of freedom that we had before this pandemic began. Luckily, I have still been able to continue dancing. Dance has not only allowed me to stay active, it has also taken a big weight off of my shoulders especially with all of the added stress and fear I have gathered throughout quarantine. I dance because it makes me happy. Dance allows me to express myself in a way that only I can. Each movement varies from person to person which is why so much emotion can be expressed while dancing. The dance community is very tight knit. I do my absolute best to understand, and provide everyone with the same amount of love and support that they give to me. Although the light at the end of the tunnel is not visible yet, I will continue to move forward and dance will be next to me every step of the way.

—Olivia T.

ESSENCE OF ART = EXPRESSION

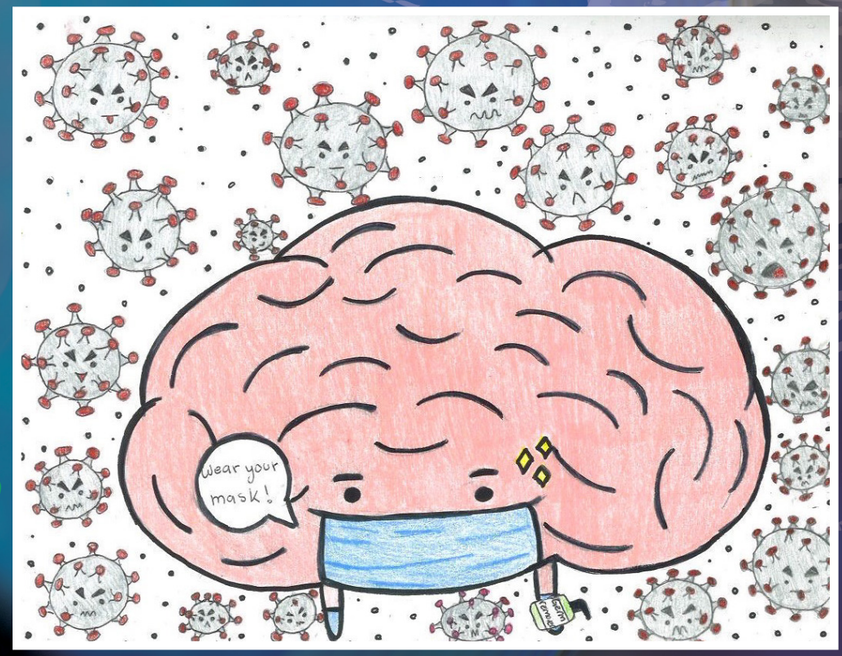
A lot of time, people don't know how to express themselves. They have trouble communicating and showing their emotions. The arts can help with that. I have been able to express myself through music and writing. I love to express my feelings by playing my violin and writing short stories. For example, sometimes I am dealing with family issues and I don't want to talk about it. When I play my violin or write, I can deal with those feelings and express them. Also, those activities have helped me to express my feelings about what's going on in the world right now with the coronavirus and the Black Lives Matter Movement. It was a lot to deal with, but these hobbies have helped me get through it. Expressing feelings means that I will have less stress. Stress leads to bad health. So, doing my hobbies and expressing my feelings leads to good health, mentally and physically.

—Emma C.

Meanwhile the world is facing a crisis, Art is a way of expression and escape from negativity. Art is a passage to another dimension where I'm able to create my own world. Art simply makes me feel better and precise about the way I see my environment.

Many people have different ways of expression, but I choose Art. Art is everywhere, if you allow your imagination you can create anything!

—Kamila D.



Srinjoy Gangopadhyay (Srin)

Childhood and Utopia

Srinjoy Gangopadhyay was born into a family of artists in Kolkata, India. His father was a very popular illustrator and studio artist, and as a child, Srinjoy was surrounded by paint, paper, canvas, and the smell of oil paint. His father's studio had books and catalogs about many artists—ranging from the great masters of Renaissance Art to Modern Art and the Surrealists. "From a very young age," he says, "I would turn the pages and immerse myself in the ocean of paintings they showed." Later, he read about many artists' lives and their artistic journeys.

On his first day of school, Srinjoy came home and made drawings of the school, his new friends, parents, and cars. His father was very enthusiastic about his early creations: He framed a few of Srinjoy's drawings to hang in the family home. There was no shortage of art materials in their house, and Srinjoy was lucky to play with them. "When I played with my clay, my father would select one of the figures from my crazy mess and announce that it was a masterpiece." Srinjoy's father would display the clay figure in a showcase in their house, alongside his collection of artifacts from around the world.

Srinjoy also spent many evenings with his father visiting the studios of artisans and potters. Srinjoy says, "On these magical evenings, I would explore the amazing artworks that were being made. I can still smell the clay in those studios and see the artists' tools scattered everywhere." When he was really young, Srinjoy would often invade his father's studio when he was busy painting, and sit with a brush in his hand, painting right next to him. After a while, Srinjoy asked his father for "that brush" he was painting with. "I thought it was the brush that made all the difference!"

Srinjoy's uncle, who was into advertising and graphic design, used to play a game with him. He would draw a few lines on a blank piece of paper; then he'd challenge Srinjoy to draw something that incorporated those lines—filling in the blanks to finish the drawing. It was Srinjoy's favorite game. In addition to visiting art exhibitions, he also got to meet many of his father's famous artist friends. His childhood was not only filled with art but also with an understanding of the larger "art world." He says, "I believed that I was born to be an artist and that I belonged in the art world," Srinjoy says. Eventually, he made art his career.

Srinjoy's father never imposed any rules or guidelines on him to paint in a particular way. He inspired Srinjoy to be intuitive and to find his own creative expression. As a result, Srinjoy believed that he could somehow create his own new kind of artistic technique. He was always very fond of collaging and assemblage. Another favorite was scribbling on printed images from newspapers or magazines to create a new image. His childhood was filled with Hindu and Buddhist mythological stories and religious art. The books on ancient Indian Art fascinated Srinjoy, especially the amazing monumental murals in the Ajanta Caves. He also read graphic novels like the "Amar Chitra Katha" series, with its stories from the worlds of mythological Hindu and Buddhist Gods, as well as Marvel and DC comics.

In his current art practice, he has focused on the theme of "Utopia," or a perfect world. He has always been drawn to images and stories of utopias. Srinjoy says, "Perhaps seeing my father as a successful artist, as well as reading about and seeing the works of the greatest artists in history, gave me a utopian image of the art world." And of course, he adds, Bollywood movies and the huge, colorful, hand-painted billboards for them could look like utopias, too.

Utopias can be inspiring models of hope. As Srinjoy got older, he learned that utopias can't always be achieved. "Confronting the failed utopias in my personal life, and in the world, made me aware of the contradictions between Utopia and reality," he admits. "This, in turn, made me interested in exploring 'Utopia' in my art." To do this, he is influenced by the visual language of "Pop" and Urban Art: internet memes, colorful vintage Bollywood billboards, Dada collages, and street art/graffiti culture.

In his "ICON" series of paintings, he uses popular images of famous personalities; he reinterprets how these personalities are generally seen, placing celebrities such as Marilyn Monroe and characters such as Mickey Mouse in stories where we wouldn't expect to see them. When the unique digital collage is created, Srinjoy incorporates it into his painting. In this way, the "ICON" collection helps us to see the world differently—just as Srinjoy's early experiences with art helped him to create a world all his own.

In Her Own Words:

A conversation with Melissa Menzer, Ph.D.

Tell us what you do at the National Endowment for the Arts.

Working at the National Endowment for the Arts brings together my two main interests: psychological research and the arts. The Arts Endowment is a federal agency that gives people the opportunity to participate in the arts, exercise their imaginations, and develop their creativity. I work in the Office of Research & Analysis, which conducts and supports research on the importance and the impact of the arts for people and communities.

Melissa Menzer

For example, I produced a research report about the social and emotional benefits for young children when they participate in the arts. [To read this report, go to arts.gov/sites/default/files/arts-in-early-childhood-dec2015-rev.pdf.]

For another project, I guest-edited (with Dr. Adam Winsler at George Mason University) a special section in the journal Early Childhood Research Quarterly *about how children benefit from being exposed to the arts and making art, with eight different articles from researchers around the world. [To view a webinar on these research articles, see arts.gov/stories/video/new-research-arts-early-childhood-symposium.]*

Are there any studies in recent years that you find especially noteworthy?

Yes. Studies that explain how the arts influence health and biology—particularly for children—help us understand how important the arts are for human functioning and child development. One project that we supported through a grant shows how taking part in art activities can "get under your skin" in a good way and reduce your stress level. [To read this research article, go to arts.gov/sites/default/files/Research-Art-Works-WestChester.pdf.]

How did you become interested in child developmental psychology as an area of research?

In college, I volunteered to work with young children and their caregivers during large play group sessions and arts activities. I enjoyed seeing the ways the children and families interacted. This experience encouraged me to think about why the kids would participate in certain activities, and what that could mean for their development. Also in college, I graduated with degrees in both psychology and studio art. I also interned in a research lab at the University of Maryland; we studied children's and teens' relationships with their families and with other kids and teens, and how those relationships affected the young people's development.

Can you discuss this line of research a little more?

Humans are social beings, so our relationships with family and friends—especially people we're close with—are important to how healthy and satisfied we feel. Even how we feel and think about those relationships can affect our well-being. There's a lot of research on this topic.

Did you find there are certain things about studying art that are similar to being a psychology researcher?

Well, they're certainly different fields. But I feel like they're a good combination and help to create balance in my life. There's an art to doing research. And, some artists conduct research before they even start on an art project, to find out the best way to express what they're trying to show.

[As for research,] it's very important to have a curious mind and the drive to know how something works, or to figure something out. Psychology researchers put a lot of thought into how we approach our research questions. You think about the people you're trying to study, or what makes the most sense for that particular group.

This issue of *ChildArt* is about the ABCD Study. Why is the study so special?

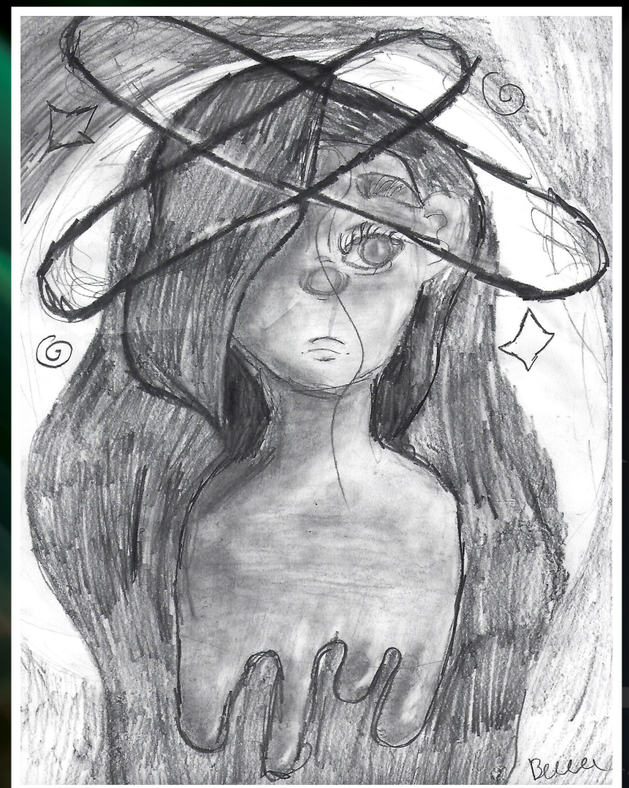
Longitudinal studies (studies that run for a period of time), especially large ones like the ABCD Study, can be really exciting. You can track people across time to see if specific experiences relate to things that happen later.

For the arts, the ABCD Study helps the Arts Endowment better understand the links between the arts and how people develop. Specifically, we hope to learn how teens' participation in the arts is related to how they develop now and in the future.

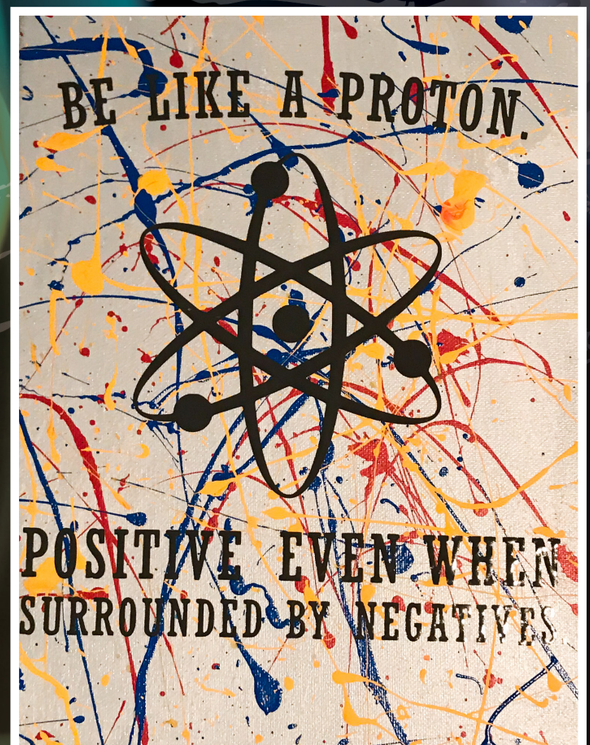
Do you still "do" art?

I took art and music lessons and courses when I was younger. In college, I focused on painting, drawing, and print-making. Now, I think of myself as an arts consumer! I go to visual art, music, dance, theatre, and poetry events; I also read fiction and nonfiction books, listen to music and audiobooks, and watch films.

By Sunil Iyengar
Director, Office of Research & Analysis
National Endowment for the Arts



Art by Alexandria J.



Art by Colin S.

When Science Meets Art

Dr. Hina Inam tells *ChildArt* Guest Editor, Dr. Katia Howlett, about her Artistic Journey to Medicine

> *Every child is an artist.*
> *The problem is to remain an artist*
> *once they grow up.*
>
> *—Pablo Picasso*

This was a favorite quote of mine when I was growing up. As a young child, I often sat on the stairs with my sketchbook, drawing my thoughts. This passion stayed with me, and eventually it became a part of my profession. Strange as it may sound, surgery and the arts are closely connected. Just as a painter thinks about and executes a painting, a surgeon is an artist creating masterpieces in the operating room (OR). I simply shifted from having paintbrushes in my hand to a scalpel.

Along my career path, the International Child Art Foundation (ICAF) has played a big role. I was once a shy little girl, but going to the United States representing my country at the World Children's Festival and meeting all those incredibly talented kids, gave me confidence. Art became my speech; it became my passion. When I felt happy, I'd draw. When I felt sad, I'd find comfort in art. It also plays an important role in who I am today.

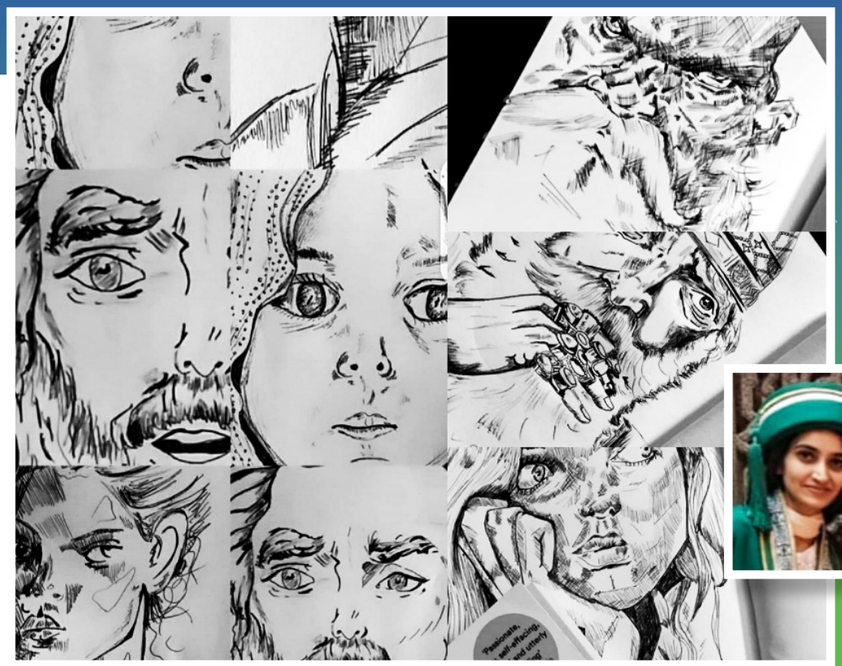
It all began on a long Sunday, when I was a medical intern at the busiest cardiothoracic (heart and chest) surgery service in Karachi, the largest city in Pakistan. I was called to the OR. Because I had worked so hard as a student and intern, I was given the opportunity to perform a "sternotomy" (chest opening). When I did, I saw the human heart and the lungs for the first time. Simply put, it was love at first sight. In that moment, I knew without any doubt that this was what I wanted to do for the rest of my life.

While I was still an intern, I started reading about cardiac surgeries. Whenever I had time, I drew different views of the heart. I was fascinated by the heart's rhythm and efficiency. Even today, while I'm waiting for the patient to be prepared for surgery, I usually sketch. This helps me "see" the steps of the operation, and concentrate on what I plan to do for the patient. It's much like the steps of a dance.

Hina at the 1999 World Children's Festival on the National Mall in Washington, DC

I graduated in December 2019 as the first female cardiac surgery resident from Aga Khan University Hospital (AKUH) in Karachi, and then joined AKUH as a Senior Resident. The job at this very busy cardiothoracic surgery service involves six days of operations and academic activities. A supervisor watches while I perform surgery. I also assist with coronary artery surgeries for adults, and with replacing patients' heart valves.

Even though my routine is very busy, I take time out to sketch, draw, and paint whenever I can. It gives me peace. It's my "happy place" after a long day's work. Art has helped me grow in so many ways: It has taught me patience, made me focus, and made me passionate. All these qualities have helped me grow in my career, too. Now my canvas is the human heart, and stitches are my paints.



Hina Inam

When Art Meets Science

Dr. Viviana Astudillo-Clavijo talks with *ChildArt*'s Managing Editor, Amy Enke

Art by Viviana Astudillo-Clavijo

One spring day in 1999, nine-year-old Viviana Astudillo-Clavijo's mother received an important phone call. Viviana had just won an ICAF art competition. She was invited to represent her country, Canada, at the World Children's Festival (WCF) in Washington, D.C. Her whole family was excited for her, and they traveled together to the event. While there, Viviana visited the White House and made new friends from all over the world.

Before the trip, a local politician heard about Viviana and brought her pins with a picture of the Canadian flag on them, to give to other children. Many of the children at WCF brought items like this from their own countries and had fun trading them with each other. Now, twenty years later, Viviana still has the pins she collected at the festival, displaying them in a frame. She also stays in touch with some friends she met there—including one who lives almost 9,000 miles away in Africa.

Viviana's interest in art began early. As a child, she loved to draw. Some of her earliest artistic memories are of drawing on paper napkins at restaurants while her family waited for the food to arrive. The love of art came quite naturally to her, but the skill of art required work. She was frustrated by wanting her art to be better, but she learned early on to just keep working. Her mother would bring her how-to books from the library, and finally, at age fourteen, she took her first real art class at a local studio. To kids today she says, "Continue exploring, embrace challenges, and use mistakes as fuel for your next project."

Viviana at ICAF's World Children's Festival in 1999.

Viviana's winning art was a painting entitled, "My World in the Year 2000." It depicts a line of children walking hand in hand, in pursuit of peace, sharing, and joy—the words she painted onto the canvas.

Today, Viviana uses her artistic skills in a different way. While earning a Ph.D. in Evolutionary Biology from the University of Toronto, she blended art with science and used that combination to teach others. Her scientific specialty is ichthyology (pronounced ik-thee-OL-a-jee)—the study of fishes; her art specialties are murals, paintings, and pencil and ink drawings.

Several times, she wondered whether to pursue art or science as a profession. Ultimately, she has found many opportunities to enhance her own study of biology with art, and to share and teach science through art. Viviana says, "Art led me to where I am today. I definitely want it to remain part of my profession. Art is not officially recognized as part of my degree program or my profession, but I find it to be a useful tool for both teaching and learning complex concepts in science." Much of her research is based on specimens of fish, and sketches, diagrams, slides, and images are some of her most useful research tools.

Many museums conduct research, and today, Viviana helps students learn how to use specimens in the natural history section of Canada's Royal Ontario Museum. She presents her research at the museum, answers questions for museum visitors, and lectures for groups of university students. She has also contributed her artworks to teaching exhibits, including a series of layered puzzles that show the anatomy of different animals.

Viviana credits ICAF with helping to foster her creativity. "ICAF gave me confidence to continue making art. It validated something that I thought was just fun as a more serious part of my life." She found inspiration at the WCF in being surrounded by other people with similar interests. ICAF aims to help develop empathy and creativity in the world's future leaders, and Viviana's story is filled with both of those qualities. Through her work as an artist, a scientist, and a teacher, she has contributed to the mission of peace, sharing, and joy that she imagined with her first winning painting.

Art by Vicky V.

NEUROSCIENCE = ART

Art by Max J.

Art is a lie,

A lie so beautiful it becomes truth.

Art is deception,

Deception so powerful it becomes reality.

Reality is the brain's playground,

Through which we are invited to roam freely.

Weighing in at a modest three pounds,

Our brain can't even seem to understand itself,

So how then does it help us understand our world?

Captive to electrical impulses,

Our experiences form our view of the world.

Our brain colors our reality,

A reality painted by the lenses of our choosing.

Captive to nerves and neurons,

Our brain manipulates our past and draws on our future.

Deception is art,

An art the brain has mastered.

Although art is a lie,

It is the brain's truth.

Although art is deception,

It is the brain's reality.

The brain is a lie,

A lie so beautiful that it is art.

—Michael Kofi Esson, Research Assistant
University of Wisconsin-Milwaukee

Art by Savannah C.

How Neuroscience Helps Answer the Question: What Is Beauty?

If someone asked you what's beautiful, you might tell them about a flower, or about a person you're close with, a painting you like, or even a building in your city. If that person then asked you, "Why is that beautiful?," you'd probably find that harder to answer. We all experience beauty differently, and we're drawn to different types of things. But why?

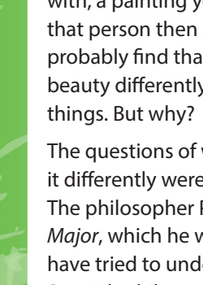
The questions of what beauty is and why we all experience it differently were discussed as far back as ancient Greece. The philosopher Plato asked, "What is beauty?" in *Hippias Major*, which he wrote in 390 B.C.[1] Since then, many people have tried to understand beauty better. In 1757, the Scottish philosopher David Hume said that maybe some people, like artists and art critics, were better at perceiving beauty because others have been biased by experiences which taint their view of beauty.[2] These debates and questions are still with us today. Whenever you disagree with a movie review, enjoy reading a novel or short story, debate a friend about how good a singer is, or admire a painting, you are making a small judgment about what is beautiful and why.

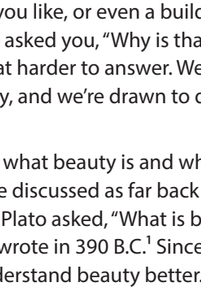
As technology developed over the years, scientists became able to understand more about what people find beautiful and why. This scientific field is called "neuroaesthetics." "Neuro" means relating to nerves or the brain; aesthetics (pronounced es-THEH-tiks) is the philosophy of beauty.

Thus, neuroaesthetics is the study of how the brain experiences beauty. Scientists that research the brain, neuroscientists, take advantage of developments in technology to investigate how people perceive beauty.

In one study, researchers used magnetic resonance imaging (MRI) to look at a person's brain activity when they listened to music. The researchers found that the more a person liked a song, the more activity there was in a particular pathway in their brain (called the mesolimbic striatum).[3] Neuroscientists have also looked at how professional artists experience things differently than novices. In one experiment, researchers found that established artists were not better at making sense of some kinds of basic visual information than novices; in other words, something else is responsible for the more experienced artists' ability to create their artworks.[4] In another, art students perceived things mostly the way non-art students did, but changes in the art students' brains were related to their increased creativity and artistic skills.

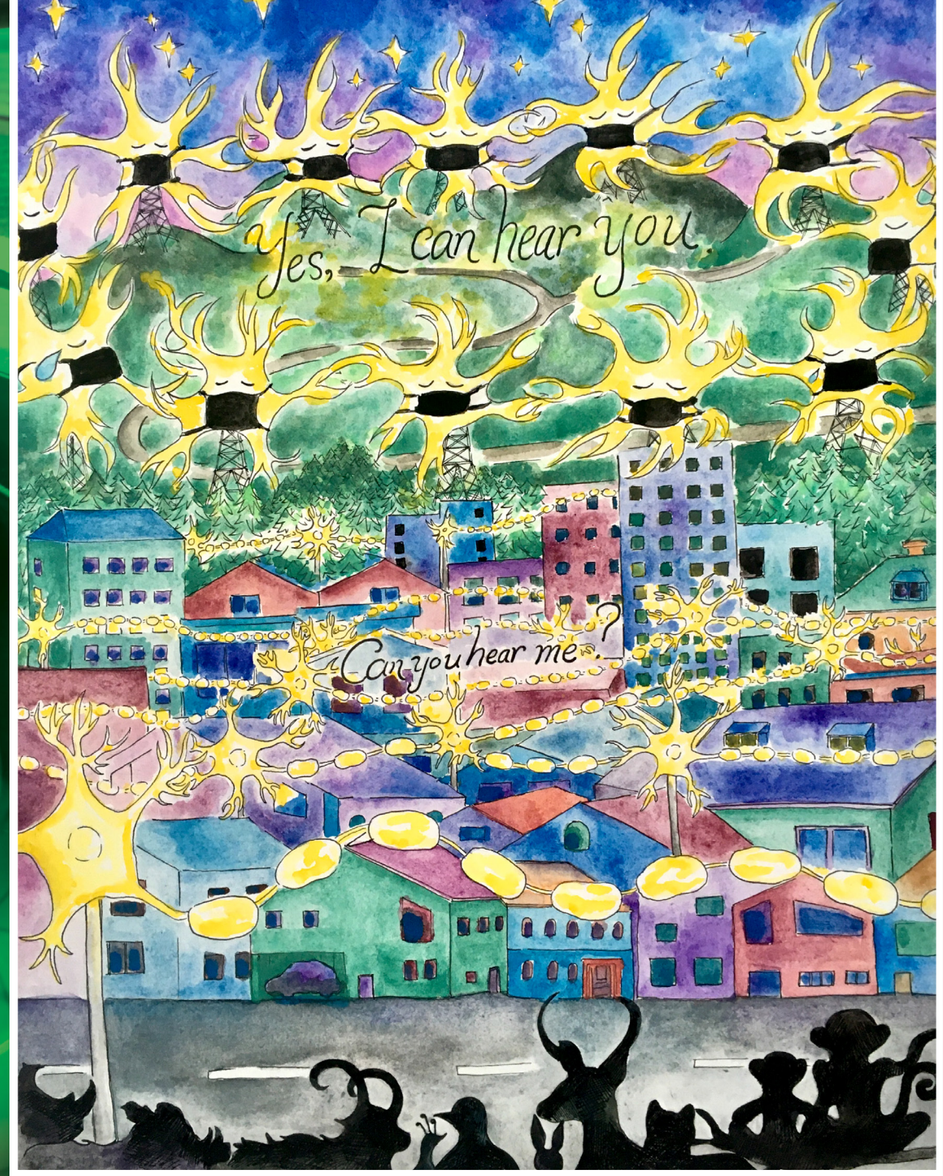
Neuroscientists have increased our understanding of what beauty is and how we experience it, but a lot of questions remain. In the future, scientists may be able to understand how to create songs or paintings that are even more beautiful than the ones we have now; they might know why humans are drawn to beauty in nature, like mountains and flowers; they might even know how to use art more effectively as therapy to help sick people get better. In the meantime, when you find yourself liking a particular song or finding one painting prettier than another, you can appreciate the beauty of both the art and the amazing brain that, together, are creating the experience.





By Calen Smith
Research Assistant
University of Utah

[1] *Plato. (1986). Plato's Hippias major. Bryn Mawr, Pa.: Thomas Library, Bryn Mawr College.*
[2] *Hume, D. (1757). Of the standards of taste. Essays Moral, Political, and Literary (pp. 226-249). Liberty Classics: https://philpapers.org/rec/HUMOTS.*
[3] *Salimpoor, V., den Bosch, I., Kovacevic, N., McIntosh, A., Dagher, A., Zatorre, R. (2013). Interactions Between the Nucleus Accumbens and Auditory Cortices Predict Music Reward Value. Science. 340 (6129), pp 216-219. DOI: 10.1126/science.1231059.*
[4] *Perdreau, F., & Cavanagh, P. (2013). Is artists' perception more veridical? Frontiers in Neuroscience. 7(6). https://doi.org/10.3389/fnins.2013.00006*
[5] *Schlegel, A., Alexander, P., Fogelson, S., Li, X., Lu, Z., Kohler, P..... Meng, M. (2015). The artist emerges: Visual art learning alters neural structure and function. NeuroImage. 105. 440- 51. DOI: 10.1016/j.neuroimage.2014.11.014*



Electrical lines and streetlights depicted as firing neutrons illuminate an American neighborhood in a moment of silence on Blackout Tuesday.

"Imagine what your mind looks like when you sympathize with the pain of others. It is fascinating that we, as humans, are created for community. We are all capable of feeling empathy. We can experience solidarity regardless of culture. Through this work of art, I hope to bring consolation to everyone that has been negatively affected by ongoing racial injustice amid the COVID-19 pandemic."

—Laili Xie, Research Assistant
University of California, San Diego

My Light

When someone dies
are they really gone?

The apples in the garden
miss your callused touch,

and the Earth, it seems,
can't weep enough.

Forever feels
more real

than the rain does.
You're gone

but the story
lives on

in a bed
of neurons

you once said,
electrical impulses

with enough power
to light

entire universes.
I wish you were here

but you are there
where stars like you

are meant to burn
like diamonds studded

in the sky,
your bright

presence
forever my light.

By Phillip Nguyen
Research Assistant
University of Vermont

Art by Jake O.

Art by Austin O.

The ABCD Data Treasure Chest

The Adolescent Brain Cognitive Development (ABCD) Study is following more than 11,800 children and their families in 21 communities across the United States. ("Cognitive development" means development of a person's ability to think, learn, understand, and remember information.) Beginning when the children were ages nine and ten, the study will follow them for ten years, collecting a treasure trove of information as the children navigate their teenage years and become young adults. It will collect information about their physical and mental health, activities, and academic progress; their environments; and the social and cultural forces that could either make them stronger or increase the risks they face. And that's just the beginning: The study is using technologies such as advanced brain imaging methods and wearable sensors to explore brain development, sleep patterns, and more.

In many ways, the ABCD Study reflects a new era of science. First, as one of only a few "big data" studies of its kind, it is collecting massive amounts of information from thousands of participants: genetic data, brain images from magnetic resonance imaging (MRI), and much more. It will all add up to many trillions of bytes of information! How is this possible? Scientists can now ask—and get answers for—bigger questions than ever before, thanks to advances in computing, artificial intelligence (also called machine learning), and data storage.

A second groundbreaking aspect of ABCD is that it uses an "open science" model. This means that any researcher anywhere in the world can apply for access to almost all of the information collected, and analyze that data on their own. The ABCD Study data could help answer many more questions than the approximately 185 scientists who are directly involved in the study could explore. Researchers can also review the answers that other researchers publish, using the same data—helping to correct any mistakes and keep scientific progress moving more quickly. This will help everybody in the scientific community—and, most importantly, the public.

Scientists are already analyzing the first two years of ABCD Study data. For example, two researchers at the University of Colorado, Boulder (one of the ABCD research sites) have shown that children of mothers who had reported using marijuana when they were pregnant had more sleep disorders.[1] This observation will now be studied more deeply to see if being exposed to marijuana while they're in the mother's womb directly affects children's sleep. (The ABCD Study will help answer many other questions about possible long-term effects of being exposed to drugs in the womb.)

A research team at the National University of Singapore (not affiliated with ABCD) studied children who consumed different amounts of caffeine and how well they learned, thought, and remembered information. The researchers found that children who consumed greater amounts of caffeine scored lower on vocabulary tests, had a harder time remembering information, and processed new information more slowly, and more. This might mean that consuming more drinks containing caffeine (such as energy drinks and many soft drinks) affects kids' cognitive abilities as they grow up; or it could mean that children whose cognitive abilities are affected by other things are more likely to drink these beverages. Finding out more about connections like this can help families to support their children's cognitive development in the most effective ways.

ABCD data are released to the wider research community once a year. In Fall/Winter 2020, the third batch of ABCD data—ABCD Data Release 3.0—will be made available on the ABCD website. This information will help us learn how children's involvement in arts activities like music, dance, and visual arts may be related to how well they do in school (see "Music's Harmony on the Developing Brain: Data from the ABCD Study" by Tim Brown and John Iversen on page 16). These data—like all the data the study is collecting—could unlock new discoveries that improve the lives of children, adolescents, and adults.

To learn more about how to obtain data from the ABCD Study, visit nda.nih.gov/abcd.

Terry L. Jernigan, Ph.D.
ABCD Study Principal Investigator
University of California, San Diego
Professor of Cognitive Science, Psychiatry, and Radiology
Director of Center of Human Development

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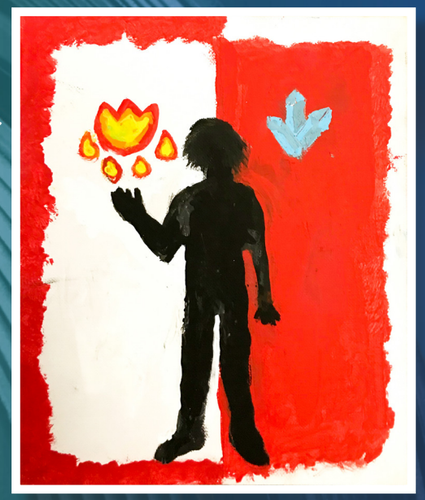
University of California, San Diego
Vice Chancellor for Research and Distinguished Professor

[1] https://www.sciencedirect.com/science/article/pii/S2352721820301352?via%3Dihub
[2] https://link.springer.com/article/10.1007/s00213-020-05596-8#Ack1

Art by Emma C.

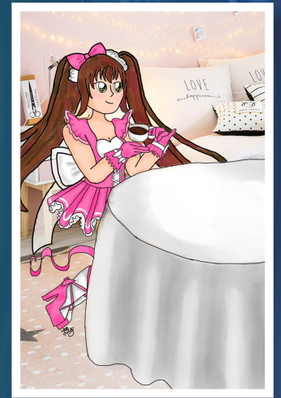


Art by Defne Y.

Art by Lillian D.

Art by Paulina G.

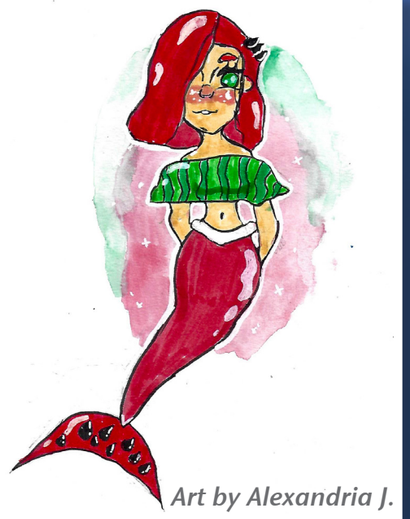
Art by Esther N.



Art by Austin O.

Art by Heather C.

Art by Annele K.



Art by Alexandria J.

Science and Art Come Together *continued from page 5*

conscious experience. He called neurons "mysterious butterflies of the soul."

We also now know that neurons, like butterflies, are constantly changing. They're always forming new connections with one another, changing those connections based on our experiences, and also—especially when we're children—allowing unused connections to wither away.

This constant changeability of the brain, called "plasticity," explains how we're "wired" by our experiences. Every experience changes the brain a little. And in the first couple decades of life, experiences have extraordinary power to shape who we are and who we'll be for the rest of our lives. From birth, and even from before birth, brain development is shaped by interaction with the environment. This includes our physical environment—the food we eat and the air we breathe—and our cultural environment, such as our family, school, media, and the arts.

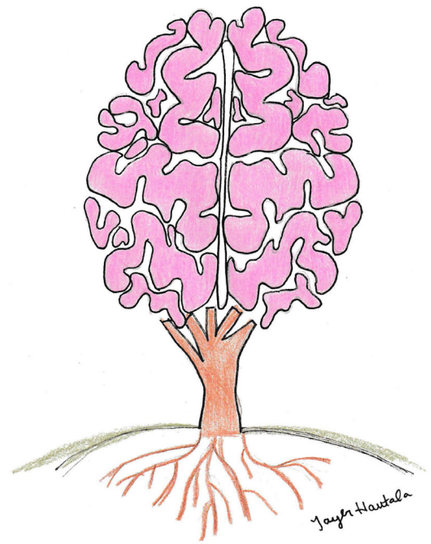
The ABCD Study

My Institute, the National Institute on Drug Abuse, is now leading the biggest-ever study of childhood experiences and their effects on how the brain develops. The Adolescent Brain Cognitive Development℠ Study (ABCD Study®) is using advanced brain imaging and many other research tools to study the changing brains of adolescents. This study follows them through middle school and high school, and into their first years of adulthood. It tracks many of their experiences during that time: not only school and physical activities like sports and sleep, but also creative activities like music lessons or other kinds of art activities.

Research already suggests that getting training in the arts, or practicing an art, strengthens parts of a person's brain. These parts include the prefrontal cortex, which is necessary for judgment and critical thinking, and the hippocampus, which is important for memory. The ABCD Study will help us answer many questions, such as: Does practicing or playing music during adolescence have an effect on a person's grades? Do arts like drawing or drama have effects on well-being?

By working with kids from childhood to young adulthood, the ABCD researchers will be able to see more precisely than ever how all of these young people's activities and experiences during their second decade of life affect both the way their brains mature, and other aspects of their physical and mental health.

This issue of *ChildArt* is devoted to the ABCD Study, with articles by some of the scientists involved in the study, and art by many of the children who are participating in it. I hope you find the brilliance and creativity of all of these people as inspiring as I do. For more information about the ABCD Study, visit abcdstudy.org.



Art by Taylor H.

Movement and Dance *continued from page 15*

versions of themselves performing the dance.

Experiencing STEM "making" this way gives young people opportunities to look at scientific facts and events in many different ways at the same time. They can also learn how to represent science in creative ways, and how to work with other students to develop and build on their ideas as part of the creative process. The students are intrigued by uncertainty through hypothesizing, testing, iteration and revision, and modeling.

Researchers can learn a lot, too. Studying learning at the intersections of STEM and the arts allows us to better understand educational experiences as a social determinant of health, specifically for youth in underrepresented communities. It can also help us to understand how making art can help young people learn STEM subjects, feel good about themselves, and handle challenges better. Dance-making is creating more than dance: It's helping young people to live happier, healthier lives.

Resources

NIDA

Mapping the Brain

https://teens.drugabuse.gov/teachers/lessonplans/mapping-brain

Developed in partnership with Scholastic, students learn about several common types of brain-imaging technology used by neuroscientists and doctors.

The Awesomely Evolved Human Brain

https://teens.drugabuse.gov/teachers/lessonplans/awesomely-evolved-human-brain

Developed in partnership with Scholastic, students learn about the brain's ability to make predictions and solve ambiguities and how drugs might compromise these capabilities.

"Wiring" Your Brain

https://teens.drugabuse.gov/teachers/lessonplans/wiring-your-brain

Developed in partnership with Scholastic, students learn that the choices they make today can help to shape and "wire" how their brains will operate as adults.

Sowing the Seeds of Neuroscience – Neuroscience 101

https://teens.drugabuse.gov/teachers/lessonplans/sowing-seeds-neuroscience-neuroscience-101

Part of the Sowing the Seeds of Neuroscience Series, students learn the basic anatomy and physiology of the nervous system.

Transforming Science for Critical Thinkers

https://teens.drugabuse.gov/teachers/lessonplans/transforming-science-critical-thinkers

Students have the opportunity to expand their critical thinking skills through this series of lessons.

Stressed Out?

https://teens.drugabuse.gov/teachers/lessonplans/stressed-out

Developed in partnership with Scholastic, students learn about how the body's stress response system works and the health consequences of ongoing stress.

Cool Science Careers

https://teens.drugabuse.gov/teachers/lessonplans/cool-science-careers

Students explore careers in science through a series of interactive exercises.

Make a Mad, Mad, Mad Neuron

https://teens.drugabuse.gov/teachers/lessonplans/make-mad-mad-mad-neuron

An interactive game that gives teens the opportunity to explore how the brain works by building their own monster neural circuit.

NIDA for Teens

https://teens.drugabuse.gov/

Designed for teens and those who influence them, parents, guardians, teachers, and other educators, the science-based information and resources inspire learning and encourage critical thinking so teens can make informed decisions about their health.

NEA

The Arts in Early Childhood: Social and Emotional Benefits of Arts Participation (a literature review by Melissa Menzer for the National Endowment for the Arts):

https://www.arts.gov/sites/default/files/arts-in-early-childhood-dec2015-rev.pdf

Arts Section of Early Childhood Quarterly issue (co-edited by Melissa Menzer for the Arts Endowment):

https://www.sciencedirect.com/journal/early-childhood-research-quarterly/vol/45/suppl/C

"New Evidence of the Benefits of Arts Education" (authored by Brian Kisida and Daniel H. Bowen for the Brookings Institution, based on research supported with a National Endowment for the Arts grant):

https://www.brookings.edu/blog/brown-center-chalkboard/2019/02/12/new-evidence-of-the-benefits-of-arts-education/

"Mind and Music Live with Renée Fleming" webinar series (with archived presentations):

https://www.kennedy-center.org/whats-on/festivals-series/sound-health/music-and-the-mind/

National Endowment for the Arts Research Labs

Across the country, NEA Research Labs are studying the benefits of the arts for cognition, learning, or social and emotional well-being in children and adolescents. Ongoing research projects include:

- University of California, San Diego, in partnership with the San Diego Children's Choir: Early Academic Readiness and Learning Intervention (EARLI) studies will test the influence of various school-day musical interventions on early childhood development.
  https://chd.ucsd.edu/research/NEA/index.html
- Drexel University (in Philadelphia), in partnership with Tracy's Kids, Medstar Georgetown Hospital, Children's National Hospital, New York Presbyterian, and Methodist Hospital in San Antonio: Multi-site study of the role of art therapy in fostering psychosocial well-being among pediatric, adolescent, and young adult cancer patients, families, and healthcare providers.
  https://drexel.edu/cnhp/research/faculty/KaimalGirija/arcs_lab/
- University of Arkansas, in partnership with The Woodruff Arts Center in Atlanta, Ga., and the Crystal Bridges Museum of American Art (in Bentonville, Ark.): Study to look at the potential non-cognitive and emotional benefits of arts-related field trips for elementary, middle school, and high school students.
  https://nea-research-lab.uark.edu/
- George Mason University Arts Research Center, in collaboration with Virginia Repertory Theatre and other partners: Study investigating the role of arts engagement, across all art forms, on children's social and emotional development in educational, out-of-school, and other settings.
  https://masonarc.gmu.edu/
- Vanderbilt University Medical Center is partnering with the Nashville Symphony, Nashville Opera, and Borderless Arts Tennessee: Study to examine if and how music may impact social-emotional development and well-being across diverse populations, including children with developmental disabilities such as autism spectrum disorders and their families.
  https://www.vumc.org/music-cognition-lab/social-emotional-development-and-community-building-through-music
  - Lab has developed an at-home "toolkit" to support parent-and-child music interactions: http://serenademusicclass.org/home-toolkit/

Other

Arts Education Partnership

https://www.aep-arts.org/

A national network of more than 100 organizations dedicated to advancing arts education supported by the National Endowment for the Arts and the U.S. Department of Education and administered by Education Commission of the States.

ArtsEdSearch

https://www.artsedsearch.org/

An clearinghouse of research on the outcomes of arts education.

International Arts + Mind Lab

https://artsandmindlab.org

Research-to-practice initiative from the Brain Science Institute at Johns Hopkins University.

VOLUME 20, ISSUE 2, NUMBER 60

OCTOBER – DECEMBER 2020

ChildArt

A View Through the ABCD Lens

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ChildArt (Jan-Mar 2021)
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Incorporated in 1997 in the District of Columbia as a 501(c)(3) nonprofit, the International Child Art Foundation serves American children as their national arts organization to foster their creativity and develop mutual empathy between them and with their peers worldwide through the universal language of art.