

In Their Own
Words
Artist and Researcher Statements

ILLUMINATION
21st Century Interactions with Science + Art + Technology
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San Diego Art Institute

Illumination

“In Their Own Words”

- 2. Curator’s Statment
- 3. Hugo Heredia Barrera
 - 4. Dia Bassett
 - 5. John Burnett
 - 6. Caitlin Cherry
 - 7. Danielle Dean
- 9. Sheena Rae Dowling
 - 10. ELSODERAC
 - 12. William Feeney
 - 14. Becky Guttin
 - 15. Janelle Iglesias
 - 17. Beliz Iristay
 - 18. Yasmine Kasem
- 19. Alexander Kohnke
 - 21. Cy Kuckenbaker
 - 22. Young Joon Kwak
- 24. Jason Xavier Lane
 - 26 Jason Manor
 - 27. Bhavna Mehta
 - 28. Anne Mudge
 - 30. Tim Murdoch
 - 32. Margaret Noble
 - 33. Becky Robbins
 - 35. Griselda Rosas
 - 36. Trish Stone
 - 38. Akiko Surai
 - 39. Amy Yao

Table of Contents

Curator: Chi Essary

In this ultra-busy world, a space for people to spend time face-to-face is an extraordinary gift—especially when those who might otherwise never meet get to exchange ideas and spur innovation. Personally introducing sixteen local San Diego artists and sixteen world-class scientists, was such an opportunity. These kinds of interactions invite creativity that can incite impactful change. Dr. Saghatelian of the Salk Institute, who participated in my first art and science exhibition, inspired me to continue this meaningful work of pairing artists and scientists when he said: "Thank you for inviting me. It helped me to think differently, which is so important to what I do."

New experiences spark ideas in both artists and scientists. By enabling artists to meet world-class scientists, I hoped to facilitate a unique experience outside the artists' comfort zones. That goal was surely met. Most of the artists were either elated or completely overwhelmed after their meeting with a scientist, but all were excited to take their practice outside of their normal mode of exploration and integrate what they learned at their lab tour.

But art is also a natural mouthpiece for science. Most of us don't pick up a science journal to find out how science will drastically affect our lives in the near future. However, visiting an art show and seeing a scientific concept depicted in the graphic metaphor or fantastical gesture of the artist makes science accessible to an audience it might have never reached otherwise. For example, filmmaker Cy Kuckenbaker spent eight hours on a microscope, delving into "alien worlds" as he called them. After witnessing a cell's nucleus and DNA divide, Kuckenbaker explained he will be printing ten thousand sheets of paper to show just how much information exists in a single DNA strand. It's these kinds of creative demonstrations that make data and science tangible and fun to talk about over cocktails or the breakfast table.

This project was also a potent reminder of the personal impact of science, with many artists asking beforehand to be paired with scientists whose work related to their life stories. This made for an exciting search for a needle in the hay stack. Hours of looking for the perfect scientist was sometimes met with elation and sometimes with disappointment if the scientist happened to be too busy to participate. But for those artists who were able to see their personal stories align with the science they experienced, the effort proved worthwhile.

Bhavna Mehta was touched to speak with a scientist who could explain what exactly had happened to Mehta's motor neurons when she had polio as a child.

Sheena Rae Dowling, after struggling with her own battle with addiction, cried when she saw a brain scan of a healthy brain compared to scans of the brain in withdrawal.

Stories like these remind us that science is far from being cold and distant—it is grappling with today's most poignant questions which affect all of us. A rare experience such as this can change an artist's perspective and ultimately what they bring to the world through their art. It is my hope that this exhibition will be rich with riveting new ideas and creative revelations seen through the eyes of artists.

Vipul Shukla

La Jolla Institute for Immunology

A major motivation for the research in Rao Lab is to understand the mechanisms by which cancers originate. Because cancer cells arise due to unwanted alterations in the normal cells of our own body, it has been challenging to design therapies that would specifically target cancer cells without affecting normal cells of our body.

As a result, the therapies used in the clinic are not always specific to the cancer cells, they have a number of side effects and are often not curative.

Our research aims toward bypassing these critical hurdles by understanding the root causes of cancer, with an ultimate goal to not only design more specific treatment strategies against cancers but to also possibly prevent the development of cancers altogether.

My specific research in the Rao Lab is interested in a group of factors called TET enzymes that change an important chemical modification in our DNA called methylation. This change of DNA methylation by TET proteins is an important process during normal development and function of all cell types in our body and perturbations in this process are often associated with development of various cancers. Many studies have shown that TET protein functions are often lost or severely diminished in many different types of cancers, but why and how inhibition of TET protein activity promotes cancer initiation remains unclear. We are directing our efforts to address these key questions to dissect out the role of TET proteins in the development of many different cancer types. Studies by us and others have revealed that loss-of normal TET protein functions in many cell types is associated with increased DNA damage, which is a hallmark of early stages of cancer development. We are currently focused on investigating the reasons for the increased DNA damage in the absence of TET proteins by using genetic model systems, molecular biology techniques, DNA sequencing technologies and methodologies for high throughput data analysis. These studies will be pivotal in understanding the mechanisms by which cancers originate and will likely pave the way for development of newer and better therapeutic regimens for treatment of cancer.

Vipul studies cancer cells, in which he sequences their DNA to functionally test changes in their genome. During my three visits to the La Jolla Institute of Immunology he showed me his fascinating experiments and some of the very complex equipment he uses.

In any given day, he can use a vast number of tools including a liquid nitrogen freezer that stores cells for many years at -320 F and a DNA sequencer that can sequence DNA in one hour, which originally took 10 years to accomplish.

After our extensive conversations about his projects, I had a large list of topics from which to draw inspiration; from single experiments to very complex data sets. However, I realized that what inspired me the most was his passion, his constant hard work in the search for new information and how critical and delicate his job is, as any piece of information can change everything in an experiment.

I found a lot of similarities between his work and my job in which I've spend 20 years experimenting with scientific glass. All my experiments to shape glass require me to use an array of equipment or to generate new equipment to facilitate the manipulation of glass. At the same time, when working with glass, it is critical to be delicate, since glass is a very sensitive material and any mistake can destroy months of hard work and experimentation.

Hugo Heredia Barrera

Changes and Damage of DNA on a Cancer

M. Reza Ghadiri

Scripps Research

We are symbionts. As humans, we have coevolved with the microbes that live in and on us. The largest concentrations of symbiotic microbes reside in our gastrointestinal tract; referred to as the gut microbiome.

It is comprised of hundreds of bacterial species and other microbes that together function as a distributed organ in our body. Naturally, dysfunction of the gut microbiome leads to the onset and progression several chronic diseases, including heart disease, diabetes, and immunological and CNS disorders. Our laboratory has been developing medicinal approaches for remodeling dysfunctional gut microbiome within a living organism into a functional healthy state to cure or prevent various diseases. Our recent studies suggest the likelihood of advancing novel personalized therapeutics for the prevention and treatment of atherosclerosis (heart disease).

When I visited Dr. Reza Ghadiri at his lab at Scripps Research Institute, what fascinated me more than the vast array of lab equipment was an illustration he showed me of the human body covered in distinct microbiomes. In fact, they estimate that there are 30-50 trillion bacteria cells on the human body, far out numbering our actual human cells. This is the information that stayed with me after our visit.

Dia Bassett

Maternal Source

In my piece, I try to capture a sense of the human microbiome through the use of buttons, brightly colored ribbons, yarn, and fabric, which represent the variety of bacteria that make up the microbiomes of our bodies. I continue to learn about the importance of microbiomes and how vital they are to physical and mental well-being for both mother and infant. “While many questions remain, it’s pretty much taken for granted that the microbial communities of the Dplacenta, vagina, and breast milk are important for fetal and infant development. But there is also an emerging appreciation for the role of the mother’s microbiome during pregnancy and lactation on the health of the woman herself” (Kerry Grens, *The Scientist* 2014). I have learned about the sacredness of the mother and her body, from the time she is shaping the fetus in her womb, and that sacredness never ends.

Though there are often thousands of bacteria in each microbiome and microbiomes all over our bodies; I focus on just five. The microbiomes that inhabit the mouth, gut, breast, skin, and vagina of the mother’s body are the heavy influencers that shape the gut microbiome of the infant. According to multiple studies, the health of your gut microbiome can help determine our overall health, mental health, and happiness. Being a new mother, I thought it most appropriate to highlight how the microbiome is transferred to the next generation from the many integral ways the mother and child interact. The mother influences her infant’s gut microbiome through skin-to-skin contact, breastfeeding, vaginal birth, kissing, and through her own gut delivered via breastmilk.

The body I sculpted is a reflection of myself. Sometimes I still mourn the birth experience that I didn’t get to have because I had an emergency cesarean operation instead of the home birth I had been envisioning for so long. So, looking at my *Maternal Source* helps me to think of all the other ways I have been able to mother well—carrying and holding my baby, kissing her, sleeping with her next to me or on me, and breastfeeding her. I look at the microbiomes and remember the power, strength, and vulnerability I felt with the birth of my daughter and that I continue to feel every day.

John Burnett

Sound Scape

Virtualized Ecology

recorded and synthesized audio, beam-forming speaker arrays

Virtualized Ecology is a sonic depiction of environmental devastation via industrialization. A variety of natural environments, which have been captured and reconstructed through field recordings, are presented throughout the course of this work. These environments gradually undergo a process of degradation, manifested through a combination of digital manipulation and the introduction of machinic, industrial sounds. Once these environments have collapsed, synthetic sounds are introduced that repair these environments to their former states. The narrative of this work posits that, although technological forces and industrialization are at fault for ecological decay, the use of technology will be vital in the reconstitution of the biosphere. (STICKER)

Prophylaxis

recorded and synthesized audio, beam-forming speaker arrays

Prophylaxis is a sonic examination of the mechanization of medical practice. This work depicts the health of the human organism through the superimposition of various indicators of health, such as pulse, breathing, EKG and other forms of bio-rhythm and electronic monitoring. Steady, rhythmic pulses as well as harmonic frequencies signify an organism in good health. This periodicity will occasionally veer into unsteadiness, as the organism's health wavers. The synthetic sounds of digital intervention then tend to the organism and bring it back to a healthy state.

New Discipline

recorded and synthesized audio, beam-forming speaker arrays

New Discipline is a sonic exploration of the ways that digital interfaces and automation have mechanized and augmented human behavior, creating new modes of social organization and, in turn, reprogramming humans to adapt to these technologies. These forces and interactions are depicted through algorithmic processes that organize and automate sonic material. The sounds used in this work span a gradient of being entirely synthetic to entirely human. Each of these materials undergoes transformations along this gradient, depicting human interactions that become digitized or algorithmic organization that manifests in the human domain.

Caitlin Cherry

Axiom

Caitlin Cherry is an artist. Their work was featured in numerous exhibitions at key galleries and museums, including the Brooklyn Museum of Art and the Postmasters. Caitlin Cherry has been featured in articles for the arrestedmotion, the Art in America and the Art South Africa. The most recent article is Mary Sibande to Exhibit at 1-54 Special Projects written for the Art South Africa in June 2019.

From Luis De Jesus Gallery Press Release:

www.luisdejesus.com/exhibitions/caitlin-cherry

Caitlin Cherry's new paintings propel her long-standing interest in the representation of black female bodies through new aesthetic strategies inspired by dystopic science fiction and malfunctioning technology. In our oversaturated screen-dependent culture, painting sheds its outmoded strategy of creating windows into literal and figurative worlds. (Works riff) on the promises of technology and marketing, and the ubiquitousness of digital screens in order to rip apart representation at the seams.

Danielle Dean

Long Low Line (Fordland)

The drawings are part of a series for an animation I am working on called Long Low Line, (Fordland), they break down landscapes found in Ford car commercials into separate layers needed for the multi-plane animation. Re-drawn from a collection of Ford Motor Company commercials archived in Detroit, where the company has long been based. The print advertisements, beginning in the 1920s, positioned the latest Ford cars against the backdrop of various American landscapes. When viewed collectively, these commercials reveal how an instrumentalized landscape has been crucial in supporting consumer culture and promoting the 'American Dream'. In these drawings, the ads are deconstructed into parts, and the cars removed.

The animation uses a digital version of a technique called the multi-plane camera, which mimics the ford assembly line, a huge apparatus used by Disney in Bambi, for example. Separate assets of the landscape move mechanically to create a parallax view. The camera splits the layers of the scene into different parts, pulling out the layers of the trees in the front, and the background, separating all parts into sections to create the illusion of depth. I was interested in this connection between the assembly line and the ideological construction of the American dream, as apart of a history of representing landscape, a part of our consciousness. The imaginary landscape affects how we connect to it, how we have justified mass consuming and destroying it. Can we imagine humans not at the center, not driving forward, consuming the space that surrounds us as if we are a separate layer?

Bug car stickers are an extra layer in the drawings and on the wall. These are to scale bugs found in Boa Vista, the second location for Fordlandia in Brazil; these bugs destroyed the rubber trees that Ford tried to crudely grow so close together.

Oliver George

Addiction Research Laboratory at UC San Diego

For much of the past century, scientists studying drugs and drug use labored in the shadows of powerful myths and misconceptions about the nature of addiction. When scientists began to study addictive behavior in the 1930s, people addicted to drugs were thought to be morally flawed and lacking in willpower.

Those views shaped society's responses to drug use, treating it as a moral failing rather than a health problem, which led to an emphasis on punishment rather than prevention and treatment.

Today, thanks to science, our views and our responses to addiction and the broader spectrum of substance use disorders have changed dramatically. Groundbreaking discoveries about the brain have revolutionized our understanding of compulsive drug use, enabling us to respond effectively to the problem. As a result of scientific research, we know that addiction is a medical disorder that affects the brain and changes behavior. We have identified many of the neurobiological risk factors, cellular types and neuronal networks responsible for compulsive drug use and are beginning to search for the genetic variations that contribute to the development and progression of the disorder. Despite these advances, we still do not fully understand why some people become addicted to drugs or how drugs change the brain to foster compulsive drug use.

The George lab focuses on exploring the individual differences in the brain that may explain why some individuals can use drugs recreationally without any adverse consequence while others will develop a drug addiction. The lab uses this knowledge to develop novel treatment approaches that may reduce the toll drug use takes on individuals, families, and communities.

Sheena Rae Dowling

More

I was very moved during my visit to Dr. George's lab where I was able to witness firsthand his research that could one day have a tremendous positive impact for people suffering from addiction. Dr. George showed me visually stunning brain scans that looked like a colored grid, relating healthy function with multiple colors in specialized areas as well as scans of a brain in withdrawal lit up abnormally. A brain in withdrawal registered primarily one or two colors showing reduced function and the specialized areas were all blurred together indicating reduced modularity. That reduced function illustrated the brain sending out the signal that it needed more of the addictive substance and virtually nothing else. The perpetual cycle of withdrawal has been a significant area of study in Dr. George's research, including an experimental compound that shuts off a signal in the neuronal cluster responsible for withdrawal, breaking the relapse cycle. This and other substances being studied could have a huge positive impact on this area of mental health.

Having had my own struggles with addiction, this empirical evidence exposed how powerful addiction is and why it is so difficult to break the relapse cycle. These signals take over and drown out everything else. It was shocking to see that in this cycle the user really has no control over whether or not they pick up an addictive substance again. The body is going through intense physical and psychological pain as well as the brain sending a signal that it needs more and the knowledge that taking more will at least stop the pain temporarily. Dr. George also shared with me that the brain can react as if it is already taking the substance even when a person only sees a visual image of the addictive substance. Seeing all his research felt so validating of the struggle I went through and gave me deep gratitude for my recovery.

My piece is meant to resemble neuronal clusters in the brain. The colors fading from one to the next represent the many functions of the brain when healthy. Fluidly fading in and out they suggest the organ's inner structure in the process of transmitting signals until the viewer pushes the button. Colors are jolted to red and a sub-brain seems to take control, remaining focused on one function until the button is released and it goes back to the oscillating colors. This effect of the brain being hijacked is much like the brain of an alcoholic or addict in withdrawal. All thoughts of basic survival-needs replaced with the most urgent command: MORE. This effect is known to many who have struggled with addiction. Its power puts the user in survival mode and can happen almost immediately for those severely addicted. They must get MORE at any cost. The work allows the viewer to control the administration of the "substance" causing the brain to react.

ELSODERAC

LUMINO-INTERACTION: Memory of Touch

In his artistic practice, Elsolderac creates objects that serve as evidence of their times. He does so as he shapeshifts from builder to designer to poet to theorist.

For ILLUMINATION, Elsolderac wants to reinforce the notion that while technology may or may not be our friend, it's definitely worth playing with.

As background to his artwork for ILLUMINATION, Elsolderac notes that technology has invaded our lives, become a part of our everyday activity, and undertakes a considerable amount of work for us: Turn on the lights! Play NPR! Keep the heat at 70 degrees! Notwithstanding the burden that technology accepts for making our lives better, most of us simply don't think about the other side of the arrangement: Just how does technology feel about being used so insistently by humans? Sure it's a bit of personifying and even sentimentalizing our interaction with inanimate objects.

What is possible to know is that in LUMINO-INTERACTION: Memory of Touch, Elsolderac wants to raise consciousness about our co-existence with technology. He wants to provide an opportunity to consider deepening your relationship with electronic devices by having a hands-on experience with his light switch.

(This artist statement is from the exhibition catalogue)

Ben Frable

Scripps Institution of Oceanography

Where do ichthyologists go to help differentiate and define fish species? Where do fisheries biologists study historic population and diet change? Where do archaeologists go to ID mysterious fish bones?

A museum fish collection, of course. Picture a library with compactorized shelving, but instead of books, there are preserved fishes in jars of isopropyl alcohol. It may sound morbid, and it is to some degree, but far from the setting of the 90s horror *The Relic*, a collection is an invaluable scientific and cultural resource. I manage the Marine Vertebrate Collection at Scripps Institution of Oceanography in La Jolla. It is the 8th or 9th largest collection in the US. My role is to organize, preserve and facilitate access to over 2 million preserved fish specimens representing about 6,000 species that were collected from around the world over the last 135 years. Personally, I study how fish species are related, how to tell them apart and how they spread through time and space. I am not tied to a specific group and have worked on everything from South American freshwater fishes to (more recently) Indo-Pacific coral reef fishes. This sometimes involves describing species that are new to science. It is exceptionally rewarding to 'name' a species. Prior to taxonomic work, I thought species discovery was a rare event, but there are actually 300-500 new fish species described every year! Our lab, the Hastings Lab, also studies multiple aspects of fish behavior-how they interact with one another and why they move and live where they live.

Beyond working with scientists, I also have had the privilege of assisting artists like Bill Fenney. Bill first stopped by on a tour and then came in to discuss the execution his unique concept and examine some preserved sharks! Turning a shark inside out is not as easy as it sounds. Bill really pushed my knowledge of internal anatomy to the limit especially when thinking about how it would look inverted. Probably one of the most difficult aspects to capture was what the famous 'jaws' looks like from the inside. To help, we examined the partially dissected jaws from an Oceanic Whitetip Shark, *Carcharhinus longimanus*, that was collected in 1955 off Isla Clarion, Mexico. Clarion is part of the Revillagigdos, an island group in the middle of the Eastern Pacific, 300-400 miles southeast of Cabo San Lucas, sometimes called the Mexican Galapagos. It is fantastic that 64 years later, this shark from a remote part of the world helped inspire and inform this piece.

The title of this piece, “Exposing the questions which have been hidden by the answers,” is paraphrasing the American author James Baldwin, “The artist cannot and must not take anything for granted, but must drive to the heart of every answer and expose the question the answer hides.”

As an artist and someone who has been intimately connected to the ocean my entire life, I am fascinated by large sharks and our relationship to them. Our fear of sharks feeds the idea that sharks are bad, and we should be afraid of them. On the other hand, research tells us that large sharks are critical to the balance and maintenance of healthy oceans, and they pose very little danger to us.

My distorted view of the shark is pointing to situations that can arise when our emotions override our logic.

I was excited for the opportunity to work with marine biologists from the Scripps Institution of Oceanography. I was put into contact with Dr. Greg Rouse, Professor Marine Biology Research Division, and my visit with him began a bit of an odyssey connecting with other scientists both in and outside of Scripps. I met Ben Frable, Collection Manager of Marine Vertebrates at Scripps, and got to explore the vertebrate collection with him. On a follow up visit with Ben, I had some specific anatomy questions about sharks, so he put me in contact with Antonella Preti, NOAA Affiliate, Southwest Fisheries Science Center and Dr. Allison Bronson, a white shark expert from the Department of Biological Sciences at Humboldt State University.

Antonella Preti was gracious and enthusiastic when I contacted her, and she arranged for me to attend a necropsy of a Thresher sharks’ digestive system. I had an incredible experience and I learned so much that I was able to put directly into this artwork. I was also in contact with Dr. Allison Bronson by email and a Google Doc to have some of my scale and proportion questions about white shark anatomy answered.

William Feeney

Exposing the question which have been hidden by the answer

Lu-Lin Jiang

Sanford Burnham Prebys
Medical Discovery Institute

Alzheimer's disease (AD) was first discovered by Dr. Alois Alzheimer in 1906, when he noticed the appearance of abnormal clumps (amyloid plaques) in the brain of a woman who had died of an unusual mental illness.

Since then, AD is the most common neurodegenerative disease, affecting over 3 million Americans every year, and is ranked as the sixth leading cause of death in United States. At this time, it is an irreversible and progressive brain disorder destroying memory and general brain functions. The accumulation of toxic amyloid clumps in the brain of AD patients indicates the occurrence of neuronal damage. Although how the toxic protein components within these amyloid clumps interfere with neuronal function are not fully elucidated, we are seeking to learn how we can alter the course of brain dysfunction by affecting the accumulation of those amyloid proteins.

Glia, another major neural component besides neurons in the brain, initially were considered the "glue" to keep neurons in place. We have since learned that glial cells can serve as scavengers to clear amyloid from the brain and maintain the functional capacity of neuronal networks in the brain. However, if glial cells become chronically irritated, they may release toxic signaling substances which may damage the brain further. In my research in the Xu lab, we hope to can find some manner to manipulate glial cells to enhance their protective activities, namely their ability to remove toxic amyloids without triggering a chronic toxic signaling response from these cells.

How do we study these finicky glial cells in the brain, and how do we study their transition between normal resting and chronically irritated states? This is not an easy task...especially if we are studying human glial cells. We cannot take those cells directly from human brains. Our solution to this problem is rather unique; we generate microglial cells in the lab from human stem cell lines. Different gene mutations associated with AD onset from Genome Wide Association Study (GWAS) database were introduced in those microglial cells. This allows us to model human AD-associated cells in a culture dish, study how those cells carrying different mutations behave, and investigate the potential pathogenesis mechanisms. Additionally, we also use those cells as a platform for drug screening purposes to look for potential compounds that can enhance the clearance capacity of those microglia. These cells can also be injected into mouse brains. The mice are genetically modified lab animals to model human AD patients. This allows us to image these microglia while the mouse is living (and if old enough, may show signs of memory loss), and determine how these microglia react with the diseased brain environment. We can see how many of these microglia are moving towards disease plaques, and sample fluid from the brain to see whether the toxic amyloid protein in the plaques can be removed by human microglia. We hope we can benefit AD patients through our research in the near future.

Since I was young, I have heard how Alzheimer's disease (AD) affects not only the unfortunate person who has it, but his/her family and friends as well.

Becky Guttin

Clean - Dirt - Dust

Visiting my new friend, scientist Lu-Lin in her laboratory was extremely interesting and special. She talked about Alzheimer's disease from the scientific point of view. Her knowledge helped me understand better what causes it and how difficult it has been to find a cure or to slow down its progression. She explained that when a person is suffering with Alzheimer's disease, the "bad protein" called Beta Amyloid accumulates in the brain, adding "dust" to the brain cells.

While listening to Lu-Lin and looking at different images and diagrams, constantly repeated were the words: CLEAN, DIRT, and DUST. When I started to think about my project, I had the intention to experiment and play with those concepts.

I started working with pieces of used aluminum and compacting them into squares blocks of various sizes. In some of the compacted blocks one can see leftover colored ink, as the aluminum was previously used in the printing business. This symbolizes the Amyloid plaques--dust and dirt---that accumulate in a brain with Alzheimer's disease.

The colorful grass line in the center evokes the healthy and clean cells in the brain that allow the person to recognize, feel and understand. It also divides the piece into two sections, like the lobes of the brain.

In a sense, the tree is the neural degeneration that while standing and alive, has accumulated debris on its branches represented by aluminum covering. The flowers, are the growth and hope. Both, the fake grass and flowers represent the vitality of nature, with at the same time an internal desire to survive.

JANELLE IGLESIAS

Gesture of Living

When my father passed away in 2014, I was deeply disturbed that real flowers were banned from the cemetery. A ‘florist’ on site prepared plastic bouquets, arrangements tied in bows and covered in glitter. While these artificial blooms never die, my mother receives an email each season reminding her to buy a new arrangement with each successive holiday.

As an artist, I’m interested in our complicated and commodified relationship to nature.

In my practice I collect materials that speak to the strange powers that material culture and consumerism exert on our daily lives. Through creating unlikely sculptural situations, I instigate new connections between seemingly unrelated objects and materials.

Peeling barcodes and brand stickers off the skin of fruits and vegetables has become a new routine. There are the barcodes with their coded data, the corporate symbols with their slogans, as well as the tiny advertisements with cartoon characters from the latest movies. Neon green announces they are ORGANIC and NATURAL. I’m both put-off by their irony and charmed by their design.

A few months after my father passed away, I encountered an artificial fig tree at a thrift store and brought it back to the studio. It was sad and dusty. Rather than watering it and watching it grow, I’ve added stickers to the plastic leaves, witnessing their spread over time. A sculptural sticker album. Signs of consumption, consuming. Gestures of everyday life, imposed on something dead.

Deniz İlkbaşıaran

UC San Diego

What are the consequences of not having full access to a language early in life?

Languages represent, archive and shape distinct observations and experiences of their people, in a way that uses and celebrates the sensory and expressive capacities of their bodies. Humans use a range of these bodily resources to relate to one another. Sign languages appear and change naturally among deaf communities just like spoken languages do among hearing communities. Whether signed or spoken, every language employs complex grammatical strategies.

As the human brain matures, it is constantly shaped by experience, linguistic and otherwise. Research shows that our brains are most sensitive and flexible in infancy and early childhood. Deaf children who learn a sign language early in life follow similar milestones in language development as hearing children do with spoken languages. However, although a hearing child has access to spoken language effortlessly from birth, many deaf people around the world do not have effortless access to a sign language in their child-

With sign language, deaf people can have complete access to a first language, allowing them to fully understand and express themselves in society. Because of this, sign language is a basic human right for deaf people.

At Professor Rachel Mayberry's research lab, we study the long-term effects of late first language learning on deaf people's language outcomes and how their brain organizes for language. We combine behavioral and brain imaging methods (e.g., fMRI, MEG) to discover how deaf and hearing people in the United States who have learned sign language at various ages process, understand and produce American Sign Language (ASL). Our findings show that the sensitive period for language is most critical for first language development. Deaf adults who have learned ASL early in life use similar brain areas to process ASL as hearing adults do for their native spoken language. On the other hand, missing the necessary linguistic foundation early in life alters the neural structure and pathways that adults use to process language, and has long-term effects on the mastery of complex grammatical sentence constructions.

As an artist, I explore ideas around shared heritage and traditions coming from different cultures that I am a part of. As a social scientist, Deniz explores the relationships between language, society and technology, by studying sign language and deaf people from different communities. Therefore, I invited Deniz to co-create for this project with me, because we are both interested in the visual patterns found in social life.

Beliz Iristay building

Our collaborative creation process began with the exchange of ideas, texts and visuals, followed by a production phase that took place in my studio at Guadalupe Valley, Baja California. Our conceptual starting point was findings from the research that Deniz has been involved with at UCSD. Their research shows that our brains are most sensitive and flexible in infancy and early childhood. The earlier deaf people learn and use sign language, the more equipped they are later in life. So, depriving deaf children of sign language can have serious long-term consequences through adulthood. Based on this, we imagined a sculptural installation, centered around a wall that uses Mexican adobe bricks with different handshapes from American Sign Language (ASL) as its building blocks.

The wall has two sides. On one side are negative ASL handshape impressions, going up from simple to complex. The handshapes at the bottom come from a child's hands, using the first handshapes that a child would typically learn and produce with ease. Moving up with each layer, developmentally more advanced handshapes are explored and combined playfully by Deniz. On the other side of the wall is my visual interpretation of their research, through design and patterns inspired by this research and related scientific images. For this I use a combination of traditional and contemporary techniques with ceramics.

YASMINE KASEM

al Zahab al Abiad/Kanz Siti

White Gold/Grandma's Treasure, 2019

Dad, you never really speak of Siti. Even though her portrait rests on the mantle above the fireplace. She's watched me for years. Chin raised and her stoic, wrinkled face and eyes -- I could never decide -- of sad, tired or sage glare.

Swallowed in white, silent and tattooed with diamonds and vines that grace her face, like a promise of Jannah.

I don't know what they mean; I ask but she never answers.

Siti answers only through the softness of matted gold.

Pulling. Breaking. Ripping. Snarling.

Unraveling.

I unravel to sustain my identity. Undo, and make a new body, where history is unhidden and its fragility is visible. And in its unraveling and reformation, I find a fragile connection to my Siti (grandmother), whom I never met. I unravel this material and reform it into a new body that must maintain itself against its precarious situation. These bails are the amalgamation of a complex identity, its history, and the act of sustaining it. Composed of American and Egyptian cotton, the various fibers and their qualities are unraveled from their previous material bodies, ripped and carded into a dense mass that is tasked with sustaining its balance. As a Queer Muslim, and Egyptian-American, sustaining identity is a constant state of transforming and refiguring the layers of self within one body. The cotton bails rest atop of one another, marked with indigo in the fashion of my Siti's facial tattoos. Their softness and density weighing heavy on its suspension, struggling against gravity and the threat of collapse.

Similarly, Egyptian cotton is a material intertwined with my personal history and a global market economy. Which today, the practice of growing and exporting cotton inflated by colonialist trade practices in agriculture, impacts the climate and is impacted by climate change.

Introduced as major financial crop in Egypt in the 19th century to King Muhammad Ali, cotton provided conflicting roles: financial gain and opportunity for Egyptians, but eventually peasantry for farmers and contributing to the colonization/ occupation of Egypt by the British. Unraveling and carding the cotton piping, filler and top roving to make these bails, I reference the traditional labor of Egyptian women in the textile industry unaffected by the European industrial revolution, who's automatic looms displaced and destabilized work for many Egyptian women who wove by hand. Overlapping this era, my Siti's family were merchants in the town of Al Kays and sold predominantly raw cotton in the 19th century and early 20th century. Since never knowing Siti, her family or history, cotton acts as a channel to connect with her as the Matriarch of my Egyptian heritage.

Dmitry Lymkis **Salk Institute for** **Biological Studies**

The biological building blocks of life are organized along a vast continuum of size. Organisms can be viewed as assemblages of organs, organs consist of tissues, tissues are made of cells, cells are made of proteins (and other molecular assemblies), and finally atoms are the foundation for it all.

Since the advent of light microscopy several centuries ago, researchers have been unraveling connections between biological structure and function along this continuum at increasingly finer degrees of resolution. We are now able to visualize the precise organization of atoms within individual proteins, and this level of detail is providing important insights into how protein dysfunction can lead to disease.

Dmitry Lyumkis is an Assistant Professor in the Laboratory of Genetics at the Salk Institute for Biological Studies. He seeks to understand how protein structure influences protein function, with a particular emphasis on the study of proteins involved in human disease. To accomplish this, he uses imaging techniques that generate atomic-level representations of the three-dimensional structures of proteins and protein assemblies. The specific technology is called cryo-electron microscopy (cryo-EM), which relies on freezing proteins at cryogenic temperatures and using a transmission electron microscope (which relies on electrons instead of light) to image the frozen samples at very high levels of magnification.

His lab is currently focused on using cryo-EM to examine protein structures within the human immunodeficiency virus (HIV). This approach allowed Lyumkis to understand how HIV creates a permanent infection in target immune cells, and these insights can now be used to design therapeutics for blocking HIV infection. The Lyumkis lab is applying this approach to a range of human diseases, with the goal of improving therapeutic strategies and helping to develop more effective pharmacological interventions.

I was immediately fascinated with the elementary process with which a virus infects a cell at the molecular level. The power of an electron microscope gives us access to a world previously hidden.

Alexander Kohnke

cross hatch 01-04

The research, using highly sophisticated tools, focuses on a very elementary task: making processes visible to the human eye. The ability to see molecular structures and how they behave is key to the research—not different in how we would observe animals in the wild just at a different scale.

The process of discovery and observation plays a major role in the research as well as in my own work. Access to new tools and methods leads to new discoveries. Seemingly known objects contain layers of undiscovered insight and new meaning by looking at them in a different way or with a different tool.

My subjects are barn owl pellets; regurgitated, mummified-looking remains consisting of bones, fur, claws and teeth; the leftovers of the nourishment of one and the demise of another. At their larger than life scale, they tell the story of life's process: birth, survival, inevitable death and rebirth, and everything in between. In an attempt to map its haggard landscape, the cross hatch on the glass tries to instill a sense of logic and reason. It is a scientific attempt at abstracting life itself.

My piece is about mystery, discovery, the attempt at translating a natural occurrence into thoughts, words and abstract concept – and the perils thereof...

Zbigniew Mikulski La Jolla Institute for Immunology

Simply known as Z. around La Jolla Institute for Immunology, Dr. Zbigniew Mikulski loves microscopy for the super-human power it gives us. Microscopy has transformed our understanding of life

With its help, we have learned that all living organisms share key characteristics. Beings as diverse as animals, plants, and fungi are all made of individual components called cells. Each cell is autonomous but highly dependent on its immediate and more distant neighbors. Studies of many diseases reveal how invading microbes and cancer cells manipulate this gentle network of connections to their own advantage. Our bodies are protected from invaders and tumors by the immune system, which evolved over many eons in our constant fight for survival. When the immune system is over-reactive we experience autoimmune disorders; when it's too lax, we succumb to infections and cancers.

Scientists at the La Jolla Institute study the details of how the immune system works, up close and personal. Z is an expert in the imaging methods that show how cells move around, communicate, live, and die in real time. He uses them to help in the work of discovering the mechanisms of diseases ranging from asthma to Zika infection.

With recent advances in microscopy techniques, we can see smaller components of cells, down to the level of single molecules. It's almost like we have learned to break the laws of physics, because for years it was believed that no light microscope could ever have resolve such small structures. The laws of nature are sound and solid, but we were able to find a back door, thanks to our ability to control the behavior of atoms, and increasingly fast computers. Through the use of advanced algorithms, we can computationally clean up the images, revealing underlying biological mechanisms. Microscopy once more transforms the understanding of biology, providing us with unprecedented view of how cells actually work.

Z says, "Working with Cy was a wonderful experience. He showed the same intense need as the scientists at the La Jolla Institute to deeply understand the method he was learning. I was surprised by his almost analytical approach to the creation of his art. It once more turns out that---just like the cells in our bodies---we are more connected and similar to each other than we might think."

I visited the microscopy lab at the La Jolla Institute of Immunology three times between November 2018 and May 2019. On my first visit, scientists Dr. Zbigniew Mikulski (aka Dr. Z) and Dr. Sarah McArdle gave me a tour of their facility and an overview of their research. On the next two visits, Dr. Z helped me use one of their microscopes to image living human cells.

Cy Kuckenbaker

Chromosome 22

It's very hard to summarize the emotional impact of these encounters. The work they're doing at LJI is a fundamental challenge to my perception of self. Like many, I've understood myself to be made up of discrete organs, all of which are described around their functions, in the simplest terms.

This is the medical understanding I absorbed through high school and college biology courses. Those experiences were a dull walk through endless taxonomies punctuated by lab experiments that didn't smell good. As a younger person, I had little interest in biology. My favorite science was astronomy - it was visual, philosophically challenging and took place on a grand scale.

These encounters with Dr. Z and Dr. Sarah are the first times I've ever experienced biology in a way that felt like astronomy. Operating the microscope felt like (imagined) space flight. The world they're exploring is three dimensional, inconceivably vast and describes human tissue not with taxonomy but as a chimeric assemblage of aliens. It's breathtaking.

This video, documents human cells multiplying but it also captured me, a very excited amateur, pushing and pulling at the controls of a space ship. (microscopes really are space ships if you think about it) The screen is the view from the ship, what's before you is something wondrous - living human cells that are reproducing outside the body. They are immortal.

At the microscope, I was amazed to see cell nuclei split. I wondered how much data is in the nucleus of a human cell? Printed pages are a familiar metric, so I decided to print one chromosome sequence on paper. This 10,000 page document represents chromosome 22. It is the smallest of the 23 human chromosomes. Most cells in the body contain the full set of 23 chromosomes, and an average adult human has trillions of cells.

The wallpaper pattern is made from images of the scientists working. The repetition of the image is a reflection of their precision and persistence.

YOUNG JOON KWAK

I use sculpture and performance to produce new ways of rethinking bodily plasticity as a hopeful metaphor for the mutability of identity and a post-Anthropocene human futurity. I take a composite approach to reimagining the materiality, functionality, and form of objects in order to propose different ways of viewing and interpreting bodies and the physical and social spaces that govern our everyday lives. I rethink queerness through the material realm of composite bodies, reflecting how bodies are always composites of other organisms, multiple forms of matter, and political and economic formations.

In my installations, I utilize architecture to create scenarios that ignite alternative forms of intimacy with objects that redefine bodies beyond the skin. An exploded mirror ball evokes bygone radical queer nightlife communities while also functioning phenomenologically via patterned light reflections slowly leading viewers' sightlines to sculptures installed in various locations (ceiling, corners, etc.), encouraging a slower and more active mode of viewing. Yonic convex mirrors affirm a queer orientation and reflect the myriad colors and forms of queer bodies in the space, rather than reinforcing the threat of surveilling our genitals as the ultimate proof of our gender-identity in order to use a public bathroom. "Shining Palimpsest" is suspended from a convex mirror from the ceiling like a chandelier, in which the language of pronouns is materialized as a single neon rope bent and twisted to spell the personal pronouns, "I-You-She-He-They-We-It," on sheets of plexiglass. As a viewer moves around the space, the piece changes visually and linguistically, words and letters appear and disappear, setting their power to signify in flux, and demonstrating the interrelated layers of meaning and obfuscation in language.

Wolfgang Busch

Salk Institute for
Biological Studies

Land plants have colonized almost all surfaces of our planet. A key to the success of land plants was the evolution of a root system, which enables the plant to forage the soil for water and nutrients and anchors it in the soil.

Roots can sense and respond to many different cues in the environment, such as differential nutrient and water concentrations in the soil; they can even sense and respond to gravity. Despite the importance for root system for plants, it is not well understood how root growth and its responses to the environment is encoded in the genome.

To understand which genes and molecular mechanisms determine how roots grow and how they respond to the environment, Wolfgang Busch, an Associate Professor at the Salk Institute for Biological Studies, makes use of the flowering plant *Arabidopsis thaliana*. It is an easy-to-grow weed, popular for plant biology research.

Different strains, all with very similar genomes, grow all over the world, making the plant especially useful for studying which genes and genetic variants make plants respond to different environments and help them to thrive and survive. Wolfgang Busch uses a systems genetics approach—which combines techniques from genetics, genomics and other science fields—to understand how root growth in given environments is determined by a plant's genes. Genome-wide association studies (GWAS) correlate genetic variation with physical characteristics, such as having long or short roots.

But to be meaningful, studies have to measure the physical characteristic of interest in significant quantities. Because it is difficult to measure roots accurately and in large numbers, Busch has employed a number of cutting-edge technologies and computational methods for evaluating roots. Using these approaches, Busch was able to uncover several genes and their genetic variants that determine how roots grow and respond to the environment, which builds a growing knowledge base as to how roots can be optimized for distinct environments or functions.

As a member of Salk's Harnessing Plants Initiative leadership team, Busch aims to help plants grow bigger, more robust root systems that can absorb larger amounts of carbon by burying it in the ground in the form of suberin, a naturally occurring carbon-rich substance. The team will use cutting-edge genetic and genomic techniques to develop these Salk Ideal Plants™ to fight climate change.

Jason Xavier Lane

Untitled 90 ton pressing #1 & #2

I arrived at The Salk Institute at 4:23 pm on Jan 23rd, taking in the view across the complex to the Pacific. I was met by Wolfgang at the security station and we then traveled down into the depths of the building, a large portion of which is underground, and into a labyrinth of laboratories.

Wolfgang and his team showed me their process of growing tiny flowering plants in multiple, specially fabricated rooms which can recreate the climates and daily changes of anywhere on Earth, now, and in our projected future. They then take these plants and break them down to the level of the genome to modify them. Spinning, cutting, crushing and examining with electron microscopes, they splice their genetic fabric in order to understand and effect the genetic actions of their roots. This is with the hope of learning how to adapt plants and perhaps ourselves to survive and thrive in our future world.

After the tour of the labs we went back to Wolfgang's office and he showed me microscopic photos and videos of these roots growing and reacting to their environment. Their actions dictated by what seemed to me to be an intelligence that is stored in each of the genes of each of the cells of each root. By identifying and modifying these genes they can change the root's behavior to (hopefully), adapt to grow in different climates and soils.

After telling me how he became interested in plants from a young age, I asked about a book from his library and he opened the pages to a set of beautiful hand drawn illustrations from the 1800's of detailed root systems, all the life of the plant that is underground. This reminded me of the Victorian practice of flower-pressing, an activity both sentimental and scientific. It was from these illustrations, the historical root of their scientific work, that I drew the inspiration for my piece.

As I returned to the ground floor and a beautiful sunset on the promenade of the Salk, I was filled with contradictory emotions of shared interest and hope in their research and a strange unreasonable empathy for the plants undergoing this process.

Using the pressure of a 90-ton (180,000 pounds) metal forming brake and a custom manufacturing die, I've made integrations into paper of *Arabidopsis thaliana* and other plants that Dr. Busch uses in his research, bringing out a form similar in structure to Wolfgang's antique book plates. My work exposes and transforms these plants that may hold our future not unlike the Victorian flower-pressings and their role in the beginnings of the science of botany.

Shadi Dayeh

UC San Diego

Every bit of telecom information exchanged between users is sent and received by a transistor amplifier.

Whether for civilian or military applications, a power amplifier emits the signals for transmission through space and a low noise amplifier conditions the signals at the receiving end. This data exchange is regulated over frequency bands, and to exchange massive amounts of data at high speeds, ultra-wideband transistor amplifiers are needed to stack as much frequency bands (i.e. information) as possible. However, transistor amplifiers do not amplify the signals at these different frequency bands equally: Usually, signals at lower frequencies are linearly amplified (output is linearly proportional to input) but signals at higher frequencies are non-linearly amplified. Due to this non-linearity, spurious signals are exchanged and as a result, power and signal fidelity are lost. Costly and large size 'linearity-correction' circuits are used to recover some of the original signals at higher frequencies and powers, but these techniques do not work at the much-needed higher frequencies of the fifth generation

We developed at UC San Diego an intrinsically linear amplifier transistor without the need for circuit correction techniques. A single device enables the transmission of wideband signals at different powers without distortion. The device prototype exhibited here is composed of a single contact to inject current and a single contact to extract current. Between these contacts are current carrying channels whose current-carrying capacity can be modulated by applying a gate voltage. These channels are composed of one very wide region, called planar region, and multiple narrow mesas called 'Fins'. As the Fin width decreases in size, a higher gate voltage is needed to pass current through it. Therefore, as the gate voltage (amplifier input) is increased, current (amplifier output) initially passes through the planar region, then through both the planar region and the wider Fins, and then through the planar regions and the wider and the narrow Fins. This means that the current (output of amplifier) is sequentially synthesized to provide a linear response as a function of the input of the amplifier.

The amplifier is made of gallium nitride, which is capable of delivering high power and high frequency operation. The method of fabrication is scalable and is made on 6 inch and 8 inch Silicon substrates. The technical properties of the transistor amplifier are as follows: Cut off frequency (f_T) and maximum oscillation frequency (f_{max}) were 71.3 GHz and 123.4 GHz. The linearity figure of merit, the ratio of output 3rd-order intermodulation intercept point (OIP3) to DC power (PDC), $OIP3/PDC = 15.7$ dB with an OIP3 of 40 dBm at 5 GHz and a reduced third order intermodulation power by 400X in reference to a conventional planar device. At 18 GHz, the carrier over third order harmonic (C/IM3) of 35.8 dBc and an OIP3/PDC of ≥ 8.8 dB with an OIP3 of 33.6 dBm.

Transistors are the tiny switches and amplifiers that power all of our electronic devices and communications systems.

Justin Manor

FINFET Macro

Unfortunately, transistors suffer from a problem known as non-linearity; they don't perform the same at different power levels and frequencies. Imagine a phone that worked fine for people with deep voices, but made high pitched voices too quiet to hear.

Shadi's research into transistor design aims to make them more linear. His team achieves this by adding variable size fins at the nanometer scale to the transistor surface. The fins, see on the piece in the bronze finish, smooth out the signals.

The artwork created from this collaboration takes the nano-scale surface of the transistor and blows it up to be human scale in a metal sculpture. Electronics, nanotechnology, and quantum mechanics can be mysterious to non-scientists because the structures are unseen, or even un-seeable. By expanding a single transistor up to a few feet in size, we can begin to relate to its form and purpose on a more human level.

Samuel Pfaff

Salk Institute for
Biological Studies

The brain has exquisite control over the body's 650 muscles, allowing us to perform tasks with ease that are difficult for even sophisticated robots.

We often take the precision of our movements for granted until we have a personal experience with stroke, spinal cord injury or disease such as Polio, Parkinson's, ALS or spinal muscular atrophy. Each of these affects the nervous system differently, nevertheless, they illustrate how a number of sites within the brain and spinal cord are involved in controlling movement.

The Pfaff laboratory specializes in the study of the spinal cord. We research the genetic basis of spinal cord circuits. This allows us to better understand how the different types of neurons residing within the spinal cord connect to and communicate with each other, as well as to the muscles that they control. Ultimately, as our understanding of the spinal cord improves, this may be used in the search for therapies that can cure diseases and repair injuries. The complexity of the spinal cord presents many challenges for this search.

Meeting Bhavna was a pleasure. She's curious, passionate, and creative. Her interest in our lab initially came in part from a personal experience with polio disease but she quickly became very interested in many of the basic science questions of spinal cord function. Bhavna sits in the tradition of those, like the pioneering neuroscientist Santiago Ramon y Cajal, who create images that are as beautiful as they are accurate.

The spinal cord starts at the base of the brain and runs through the spinal column. At any cross-section, it can teem with activity. Neurons communicating via synapse are responsible for sensation, pain perception, proprioception, movement, and the voluntary and involuntary dance of organs.

The layering of paper shapes and forms to represent the white and grey matter of the cord builds a narrative of symmetry and repetition while the colors point to function and interaction. Enlarging the cross-section of the spinal cord around 200 times, we can highlight the various regions (in broad strokes), showcasing the different categories of neurons, as well as tell a visual story about motor neuron disease.

Loss of a significant number of motor neurons changes a body. When I talked to Dr. Samuel Pfaff from the Salk Institute about how the polio virus invades the motor neurons in the spinal cord, he explained that the motor neuron has a receptor which the virus attaches itself to enter the cell body. Multiplying within the cell body, the virus destroys the neuron from within. PhD students Peter Osseward and Ben Temple from the Pfaff Laboratory have been instrumental in my understanding of how neural messaging within and beyond the spinal cord responds and activates muscles, sensation, and movement. Working with the lab has helped to answer the fundamental question of how my disability came into being.

My old x ray expose the fact that the story of your life is written on your body. Color and thread, shape and nuance, form and desire, science and story – weave in and out, searching for meaning layer upon layer.

Bhavna Mehta

Fault Lines

Ferhat Ay

La Jolla Institute
for Immunology

Imagine a room with 30,000 LED lights in different colors, each of which can be turned on or off, or adjusted to emit a precise amount of light. Now imagine that the activity of each light is tuned by the combination of hundreds of control switches scattered all around that room. Obviously, you can create an infinite number of colorful combinations but to create a specific one you just have to figure out each switch that controls each one of these lights. Incredibly complex yet amazingly beautiful, right?

Each one of our cells, tens of trillions of them that is, do this every single day. You can think of each LED light as a gene and each control switch as one of the many regulatory elements that are scattered all over the 3 billion base pairs (A, T, C, G) of DNA we have in each one of our cells. To complicate matters even more, many of the control switches that regulate a gene's activity are not necessarily lined up next to that gene in the linear DNA sequence. Instead they are brought close in 3D space to the light they control through a dynamic process called chromatin folding. It is also through this process that our cells can pack over 2 yards of DNA into a nucleus that is a million times smaller.

Our work aims to understand the resulting intricate 3D architecture and its formation. To this end, we develop computational models that utilize very large amounts of data gathered through DNA sequencing experiments with the ultimate goal of tracing and understanding the precise control circuitry of each gene. Once accomplished, this insight will revolutionize our mostly one-dimensional understanding of how genetic variants are linked to specific traits in and differences in susceptibility to diseases with a genetic component

I've long been fascinated by the astonishing architectures built out of natural processes. Consider, for instance, how the complex geometries of a hive emerge from the brains of bees the size of a pinhead. In fact, fractal geometries inform the underlying structure of the universe, extending from scales macro to micro and traversing all natural phenomena, whether they originate in the mind of a hive or spring from the networks that inform cities, the world-wide-web, or the cosmos.

Meeting with Dr. Ferhat Ay, whose field is bioinformatics, opened a fascinating glimpse into the geometries of genome architecture. Somehow strands of DNA, which measure approximately two meters when fully extended, must fit inside a cell's nucleus, which is 100,000 times smaller. The way that they fold determines how genes are transcribed from the DNA. Control switches governing epigenetic activities in the cell – which genes are expressed to make a skin cell instead of a muscle cell, or whether an individual has a greater susceptibility to a disease – are often at a great distance from the genes they are controlling. These dynamically folding strands of DNA bring them into close proximity to each other.

Dr. Ay's mathematical computations are able to map this very precise architecture. The complex geometries involved are unlike any that I've explored before. I was excited to see how these dynamic foldings would take form in my own work. I explored it using process-based methodologies, using the spring wire I've long utilized for its inherent store of potential energy. Each length of wire was measured at precisely two meters in length before coiled into growing forms.

Anne Mudge
Sixteen X 2m
Nucleus 1-3
Study A&B

Vikash Gilja UC San Diego

Electrochemical neural activity in the brain gives rise to our ability to sense, perceive, think, decide, and act. Our basic understanding of these processes is advancing quickly along with technology that allows us to measure and change this activity with precision. We put this knowledge and technology to use by developing neural prosthetic systems that allow direct communication between brains and machines. From an engineering perspective, the goal of such systems is to infer and modify “brain state” in real-time to achieve an unmet medical need. Concrete instantiations of this abstract “brain state” could be the intent to generate specific arm movements, thus allowing an individual with paralysis to act upon the world; “brain state” could also be defined as a neurological or neuropsychiatric disease state that we wish to return to a healthy state.

To advance this technology we develop experiments in clinical and pre-clinical settings in which we can interface with the brain using electrodes that are implanted in the brain or upon its surface. The data collected are incredibly rich, composed of hundreds of dimensions that vary continuously across time. We employ computational techniques from a variety of engineering fields, including information theory, signal processing, and artificial intelligence, to effectively learn how this activity maps to “brain states.” Demonstrations of such mappings have allowed paralyzed individuals to type and use computer systems. More recently such systems have shown potential for estimating intended speech, evaluating mood, and identifying engagement in specific behavioral activities (e.g. watching television vs. engaging in a conversation). As these techniques and supporting technologies evolve, they will lead to a range of new assistive devices and therapies for brain related diseases and disorders.

Discussing this work with Tim Murdoch was a wonderful experience, as his insightful questions stretched my brain with respect to how I think about my research and neural prostheses. Through our conversations, I came to realize that both Tim and I are constantly thinking about thinking and, specifically, the interplay between thought and action.

Tim Murdoch Just Nod If You Can Hear Me

In the pursuit of my work as an artist, I've always felt an affinity towards the sciences. It seems scientists and artists share certain aspects of thought that motivate creativity: an inventive spirit, intense curiosity and a desire to understand the world through differing methodologies.

When I first met with Dr. Vikash Gilja he began talking about his work with Brain Machine Interfaces (BMI). As he was explaining I could see the same excitement, passion and love for what he does that I hope is reflective in my work. BMI is exactly what it sounds like. It's the cyborgs that I grew up reading about in my extensive sci-fi library; it's an outer body experience; it's sensory as well as limb prosthetics; it's the next evolution towards immortality. His work is quite complicated if not a little ghoulish and led me to think about the nature of human consciousness and self-awareness. If we can control our external world with just our thoughts, then how far are we from occupying the same brains? What is it that separates or defines us as individuals? His work calls some of what we experience as "I" into question, not intentionally but more as a byproduct. I'm somewhat of an existentialist, so I began questioning how much our interactions are predictable according to brain chemistry, how previous behaviors, electrical impulses and random thoughts drive our motivations and whether or not we can map our intentions as Vikash suggests.

The main body of the piece is composed of sections of eucalyptus limbs collected from a singular tree that died after the last draught. I've cobbled together the different sections to create or re-create a wholeness and secured them with removable spikes. Attached to the "trees" are birdhouses that contain proximity sensors. On the floor, next to each tree is a surplus solenoid doorbell. Hanging from the trees and strewn about the floor are the various wires that carry electrical signals to a micro-controller that lies beneath a sheet of handmade paper. The paper is 19" x 19" and reflects the dimension of the cerebral cortex of the brain if the folds were ironed out. The paper is composed of my personal data collected over the years and recently shredded due to a break-in where my identity was stolen along with the documentation of my life's work. When a person approaches the trees the sensors send a signal to the microcontroller that in turn rings a doorbell.

In my work, I tend to examine the boundaries between things, objects, space, people and ideas. My response is somewhat humorous but at the same time speaks to the most basic element of human existence: a desire to connect. Whether it's making a human connection or connecting to make a human whole we all want to experience a completeness, an acknowledgment that we're understood and not alone. Sometimes it just takes a knock on the door or a ringing of the bell.

Matthias von Herrath

La Jolla Institute for Immunology

Creativity is the ability to perceive the world in new ways, to make connections between seemingly unrelated phenomena, to challenge the deepest ingrained ideas. Widely considered the domain of artists—painters, writers, musicians—creativity is not automatically associated with scientists.

Science is considered to be based on facts, flawlessly rational and logical, where hypotheses are either independently verified or refuted by evidence. Yet, some ideas can become so entrenched that they effectively turn into articles of faith and stall progress. It takes a fearless and creative mind to question the status quo and move science forward.

In type 1 diabetes the immune system mistakenly attacks and destroys insulin-producing pancreatic cells, leaving patients dependent on lifelong insulin injections. The perpetrators of the attack—which are called cytotoxic T lymphocytes (CTLs)—recognize specific protein fragments displayed on pancreatic islet cells and then kill them. That much we think we know for sure.

Interestingly, as inflammation progresses, CTLs that don't recognize islet-specific protein snippets start invading pancreatic tissue. These cells have been dubbed bystanders, since we didn't know why they were there, let alone what they did. Many thought they might enhance inflammation.

When we questioned the assumption that these cells just happened to be there for no good reason, we made a startling discovery. Instead of being idle bystanders, these cells actively help keep inflammation in check by dampening the autoimmune response in the pancreas. The chief anti-inflammatory role had been traditionally ascribed to what are called regulatory T cells, or "Tregs." But treatments based on expanding this cohort of cells have failed in the clinic.

It's time to recognize that diverse immune cell types, not just Tregs, can potentially rein in the inflammatory response in autoimmune disease. In fact, we are already planning ways to widen the therapeutic focus and are currently looking into whether there are ways to safely induce a bystander population of T cells to work in our favor as treatment for type 1 diabetes.

Margaret Noble's piece captures the daily dilemmas we face as scientists: The risk of missing the obvious, when we hold onto our favorite ideas too closely or merely follow trends without considering that the truth may lie elsewhere; how to reconcile the uncertainty that awaits us when we push the boundaries of the known world with our desire to establish irrefutable scientific evidence; and how to adapt to fluctuations in science funding.

Matthias von Herrath, M.D. is the director of the Center for Type 1 Diabetes Research, at the La Jolla Institute for Allergy & Immunology. His fervent research is prolific and groundbreaking - he investigates the treatments, technologies, and human systems which push forward new practices to improve patient care.

Margaret Noble

Dogma Roulette

This is no easy task as there are competing theories, stakes, and institutions which don't always agree or have systems in place to facilitate innovation across different entities. Doctor Matthias von Herrath states that there are dogmatic ideas around the disease. One dogmatic example is that "Diabetes Type 1 is solely an immune system disease and that there is one type of cell that always regulates inflammation...these are big fallacies that slow us down." While not everyone has a direct connection with the treatment of Diabetes, it is evident that all would be concerned that there is dogma associated with progressive medical research. Doctor Matthias von Herrath further states that "the biggest threat to science is that we hold onto ideas too closely."

This threat of dogma not only destabilizes our medical fields but spans widely across all scopes of human experience like a shapeshifter taking on a variety of forms in education and beyond. Does understanding come through belief or does belief come from understanding? How we see the world and the ideas we hold onto too closely not only have the potential to skew academic research but can also distort aspects of our daily experiences including our personal relationships and public systems. Inspired by Doctor Matthias von Herrath perspectives on medical research and Stephan Pepper's philosophical book titled World Hypothesis, I have created Dogma Roulette. Dogma Roulette is an interactive belief machine that questions the reliability of dogmatic world views through chance experiments modulated by a roulette wheel.

BECKY ROBBINS

Leap of Faith

The Heisenberg Experiment proved that the observer changes the outcome. My reticular activating system as an artist is always on a mission, my senses are in high alert most of the time. So knowing this and being this way has been a great discipline for me to adhere to only that which supports my creativity. Children are born innately connected to and curious about Nature, the animal kingdom, other humans and freedom. They (should) have the expectation of being cared for and loved by those responsible for them. With these things on my mind I began this painting with the image of the big brown bear being kissed on the nose by the little princess girl. There is so much that can be interpreted but for me it was a leap of faith that we must resurrect as we mature especially when faced with cynicism and fear. As an artist who is an uplifter in my heart, I paint to inspire, console and have an intimate message with the viewer. Come closer and see the details life offers that are worthy of pushing the pause button.

If you've seen my art, you know I'm a lover of the octopus. They are initiators of change, dynamic and emotional. Read the book *The Soul of an Octopus* by Sy Montgomery and you will develop your own alliance with them and probably stop eating them too! The one in this work is from a photo taken in Croatia by Martin Strmiska (@martin.strmiska) who gave me permission to paint it. They are elusive and will allow an interaction only if there is trust, faith in your intentions. Steve McCurry (@stevemccurryofficial) is my all time favorite cultural photographer who has published iconic photos that are emotionally and physically gorgeous. The image of suspended monks, hanging only by their feet fascinated me and he generously gave permission to me to paint it. This image kicked off a flurry of ideas that unearthed a feeling of vulnerability that I have when working and I can only continue when I have faith in the image and the compelling desire to paint it, especially when given permission by stellar photographers, architects, and artists to include in the storyline of my piece. One such architect and artist is Dan Slavinsky. His drawings have been exhibited in London and in this piece, his architectural fantasy of a fairy is hidden in plain sight amongst the designer seaweed. I look forward to including more in my work! @findingslav.

The phenom illustrator Redmer Hoekstra granted permission for me to paint the babies in the egg, thanks @redmerhoekstra for your faith in me!

One of my favorite books is the Pulitzer Prize winner, *The Overstory* by Richard Powers. It is the best novel ever written about trees, says Ann Patchett. The book will influence my art for some time to come. I've studied trees, their communication, their intelligence and necessity for us to live, the give and take between us. My studio is on the second floor and a tree outside my door is my constant companion and home to songbirds who provide the score to my work. A Leap of Faith requires trust, justice and morality which are the mainstays of the Egyptian Goddess Ma'at. She had a rigorous rule structure for Egyptians to abide by and at the end of their lives, their heart was measured for weight against her ostrich feather on the scale of justice to determine the afterlife of the departed. Perched above the scale is the Kingfisher which was photographed by Dean Mason (@deanmason.wow) at his wildlife habitat in the UK. You'll see his images again! In my work I love to include music: Music is a moral law. It gives a soul to the universe, wings to the mind, flight to the imagination, a charm to sadness, and life to everything, It is the essence of order, and leads to all that is good, just and beautiful of which it is the invisible, but nevertheless dazzling, passionate and eternal form. -Plato

V.S. Ramachandran UC San Diego

The Center for Brain and Cognition (CBC) at the University of California, San Diego, under the directorship of V.S. Ramachandran, conducts research on the neural basis of perception, cognition, language, attention and memory: a field called "cognitive neuroscience" or "behavioral neurology."

An additional focus is on neuro-rehabilitation.

The Center has two distinct agendas—a practical one and a theoretical one. The practical goal is to help develop new therapeutic approaches for the treatment of neurological and psychiatric patients, e.g., chronic pain, stroke, anorexia and childhood autism. The theoretical agenda is to understand the neural basis of human behavior: the question of how the activity of the human brain—a lump of jelly you can hold in your hand, composed of millions of tiny wisps of protoplasm— gives rise to all the richness of our conscious experience.

It is ironic that although we now have a vast amount of factual information about the brain, even the most basic questions about the human mind remain unanswered. Why do we laugh, i.e., make a rhythmic sound and bob our heads in certain situations? Why do we cry? Why does a salty liquid flow down our cheeks when sad? How does the human brain create and respond to art? Why do we enjoy music? What causes us to dance? What makes some of us so amazingly creative in mathematics, science, and poetry? How are metaphors represented in the brain? What is "body image" and why does it get distorted in anorexia nervosa? How did language evolve? Then there are more basic questions. How do we see color? Why can we pay attention to only one thing at a time? How do we recognize faces so effortlessly?

Neuroscientists and psychologists have, in the past, shied away from such questions, but our center has become well known for tackling questions such as these experimentally, questions that have traditionally been the preoccupation of philosophers. Already, there is talk in the literature and in the news media about the emergence of such new disciplines as "neuroethics," "neurotheology," "neuroeconomics," "neuroaesthetics," and "neuroepistemology," which would have been unheard of even a decade ago. Some of these new disciplines may hold the key to a treasury of insights into the neural basis of human nature.

For example, synesthesia, once considered an obscure condition, is now part of mainstream research in cognition and neuroscience, thanks in part to experiments performed at CBC by Ed Hubbard, David Brang and Ramachandran.

On the practical clinical side, the center was the first to show that visual feedback (conveyed through viewing a reflection of one's own painful body part) can powerfully reduce chronic pain, including phantom limb pain and chronic (complex) regional pain syndrome caused by nerve or tissue injury, maladies traditionally considered incurable even with surgery and powerful, side-effect-laden drugs. The technique even provides some relief from paralysis resulting from stroke. Remarkably, pain from osteo-arthritis has been shown to diminish substantially with this sort of visual feedback therapy. Most of these therapies have been validated in placebo-controlled clinical trials. But more research is needed to establish why some patients are helped more than others.

Griselda Rosas

RASA

This piece is based on my conversations with Dr. Ramachandra during my visit to his UCSD office in 2018. Dr. Ramachandra has a child-like curiosity, a refreshing and almost purist outlook in science and human ancestral practices.

His fascinating tangent-filled conversation, intelligent associations and scientific analysis resulted in art-speak conceptual language which was a perfect segue to creating my work for this exhibition.

I focused my research to his published paper entitled *The Science of Art: A Neurological Theory of Aesthetic Experience*. This research addresses multiple universal principles regarding psychological phenomena including Peak Shift Affect, which grabbed my attention. The Peak Shift Affect explains a well-known principle in animal discrimination learning and explains individual responses to face and body attractiveness.

Dr. Ramachandran and Hirstein compare the peak shift effect to the Sanskrit word "rasa," which means in Hindu the "taste" or essence of an impression; the aesthetic experience in transcendence; the emotional fulfillment of the soul; the nectar of life.

The peak shift involves the extraction by an individual of the "rasa" of a particular shape, color, etc. "Raza," in Spanish means "The People." Spelled with the letter "z", it is pronounced the same way as the Hindu term "Rasa". La Raza was a term coined during the mid-20th century by José Vasconcelos defining the mixture of races, cultures, and religions of Latin America people as a natural and aesthetic development for humanity.

Dr. Ramachandra's studies of the "Rasa" in Hindu art juxtaposed with the "Raza" of the new world peoples are the main focus of this stitched drawing. They address the chaotic breakdown of class and race structures after colonialism and territorialism overtook both India and the New World. Aesthetic influences migrated both ways. The "rasa" of the tiny waists of the Chola bronze Indian sculptures are thought to have inspired the "rasa" of corseted waists of the Victorian female aesthetics. These aesthetics, or "rasas", came to the new world mixing with the "rasa" of domestic new world practices. Dr. Ramachandra research proposes to rethink and re-read the aesthetical influences of art in current society, highlighting the transformative processes as these worlds collided, creating new rasas of taste as a new raza was born in the New World with the intermixing of the new and old world blood lines. My piece is a poetic intake, inspired by the unique research of Dr. Ramachandran.

TRISH STONE

Photograph: Bank of America, 2018

Photograph: Listen Up, 2018

Photograph: Too Little to Fail, 2018

Photograph: Overthrow the Government, 2018

Video Game: Something is Wrong, 2018

Video Game: Colonize NE-1, 2020

Painted Figurines: Trishes Protest, 2018

I started this project as a reaction to the election of 2016, because I felt disempowered as a voter and wanted to find a way to make my voice heard. I was drawn to the idea of public protest, and how digital tools could be used for revolution. The problem I faced was that I was just one lone artist, so I set out to duplicate myself by taking a 3d scan of my body and finding a lab on campus that could fabricate 3d prints for me. The lab asked me how many Trishes I wanted, and I asked: how many do you think I need to overthrow the government? We settled on 100.

At the time I lived in North Park, so I set out to stage tiny protests on street curbs and benches, lining up the Trishes with hand-painted signs. I imagined that they were angrier and more radical than me, willing to burn everything down and start over. I propped them up in front of big banks with signs that read "Too Little To Fail." I photographed them from their eye level, so that they would appear huge. I was worried that passerby would scoff (they smiled, instead) and that police would chase me away (they did not notice).

In 2017 I had the opportunity to teach Virtual Environments to undergraduates at UC San Diego, and so I needed to learn Unity, software commonly used for Virtual Reality development. This was the perfect opportunity to create a digital landscape for the Trishes to explore. I modeled the first game, Something Is Wrong, after the RPG games I enjoy playing, this time with a character that looks exactly like me. If you wander around the game long enough, you will eventually find other Trishes and join their protest.

I exhibited this project at gallery@calit2 in 2018, and am pleased to share the work with the San Diego Art Institute as part of Illumination. For this show I made a new game called Colonize NE-1, in response to the museum's setting at Balboa Park. I imagine the park as being a kind of museum of natural things, and that as we continue to develop away green spaces in the future, it may be that plants and animals only exist as memories and dreams. In the game, the player is asked to help the Trishes (who are on earth protesting 24-7) by collecting memories and dreams from an asteroid. Once the memories are collected they can be viewed in the shuttle. Of course, because they are memories and dreams, they can be viewed anytime.

Rusty Gage

Salk Institute for Biological Studies

Variations in the genes we are born with ensure that each brain is uniquely wired, leading to differences in how we think, learn and behave, and in our propensity for mental illness. Understanding how genes and environment come together to guide these processes is crucial to developing better ways to prevent and treat diseases of the brain.

But studying the human nervous system at the molecular level has always been challenging due to the complexity of the brain, as well as the difficulty of obtaining live human neurons for study in the laboratory.

Fred “Rusty” Gage’s lab has shown that mammals have the unexpected plasticity (ability to change) and adaptability to the environment throughout life. His lab showed that human beings are capable of growing new nerve cells throughout life, in a process called neurogenesis. He also showed that environmental enrichment and physical exercise can enhance the growth of new brain cells.

Krishna Vadodaria and Rusty Gage study psychiatric and neurodegenerative diseases of the human brain by utilizing stem cells derived from adult patients. By reprogramming human skin and other cells from patients with neurologic and psychiatric diseases into induced pluripotent stem cells (iPSCs), they seek to study the progression and mechanisms that lead to brain cell dysfunction. With this technology they tap into the potential of studying brain cells from individuals whose genetics, medication histories, and response profiles are known, also enabling the study of how drug treatments mediate their therapeutic effects. Their work has uncovered neural mechanisms associated with psychiatric diseases such as Bipolar disorder, Major depression, as well as treatment resistance among patients.

This new series of fibers is more process-based than much of my other works but not without its research grounding. Before meeting with my scientific partner Krishna Vadodaria, I was exploring readings on neuroplasticity and processing trauma from a cognitive/ behavioral standpoint. It was wonderful to discover similarities in our work beyond the process of experimentation.

Akiko Surai Untitled

Her research works toward creating neurons with the same genetic makeup as the patient's own brain cells that can then be used to test the efficacy of drug therapy. This would be a drastic improvement from the current practice of painstakingly easing into and out of drug trials over months, a process I know intimately due to my own experience with traumatic brain injury. Vadodaria takes something external, a skin cell, and alters it to support the growth of something structural, the hippocampus in the brain. This creative repurposing was a great parallel to my use of "decorative" embroidery stitches to mend mesh netting.

Part of the imaging process Vadodaria told me about in the laboratory involves a multi-colored dye process that helps differentiate these structures. One type of dye will bond to DNA for example, the bulk of which is in the cell's nucleus. Therefore, when you look at the slide you will see a strong concentration of that dye in one portion of the cell marking the nucleus. This gave me my color palette and an idea of how to organize the stitches.

I was fascinated by the process of deprogramming and reprogramming cells to turn skin to neurons. To pull from Vadodaria's research, I started to think of my stitches as the different structures inside a cell. As I stretch the mesh over the Plexiglas I think of it as a pristine microscopic slide ripe for experimenting. I imagine how my stitches might develop and divide to spread across the surface in distinct stages. This gave me the freedom to experiment with new stitches and expand the "vocabulary" of my embroidery. The structures I've created are not a direct depiction of her work or meant to be a didactic illustration but I have really enjoyed the shift in perspective our conversation gave me.

AMY YAO

Doppelganger

2016/2020

Amy Yao (b. 1977, Los Angeles, California) is a contemporary visual artist making work in many different mediums informed by ideas of waste and consumption.

Intercontinental Drift

Yao received a Bachelor of Fine Art (1999) from Art Center College of Design, CA and a Master of Fine Arts (2007) from Yale University, CT.

She has exhibited at the Whitney Museum of American Art (Eckhaus Latta: Possessed), MoMA PS1 (Greater New York, 2010), 47 Canal (Weeds of Indifference), and Various Small Fires (Bay of Smokes)

Writing about Weeds of Indifference in Artforum, critic Chloe Wymna noted, "Refusing the readymade's historical and contemporary postures—the cynical/ironic critique of the commodity form, the mystification of materials—Yao's gnomic, de-sublimated sculptures are sometimes puzzling and not always easy to love. Nonetheless, their difficulties reflect honest questions: 'What is even real?' she asks, speaking of when 'the new authentic is used to eradicate what came before.'"

Yao is a lecturer in visual arts at Princeton University, NJ.

In 1993, Yao was a founding member of Emily's Sassy Lime an all-Asian American teenage riot grrrl trio from Southern California. The band dissolved in 1997.

Yao is represented by Various Small Fires in Los Angeles, CA and 47 Canal in New York, NY.

Selected group exhibitions include: Medusa at Musee d'Art Moderne de la Ville de Paris, Greater New York at PS1/ MoMA in New York, Local Futures at the He Xiang Art Museum in Shenzhen, China, White Petals Surround Your Yellow Heart at Institute of Contemporary Art in Philadelphia, Eckhaus Latta: Possessed at the Whitney Museum of Art in New York. She has also held solo exhibitions at 47 Canal in New York, Indipendenza in Rome, Italy, Various Small Fires in Los Angeles, VI,VII in Norway, Audio Visual Arts in New York, New Jerseyy in Basel, Switzerland, Green Gallery in Milwaukee, WI, and Goton in Paris. She is represented by Various Small Fires, Los Angeles, and 47 Canal, New York.