Art is Science is Art
Part 1: The Process
Starring Suba Subramanian & Alex Naka
Produced by Stella Belonwu, Celia Ford, and Devika Nair

N1: Science, art, and everything nice. These are the things we'll be talking about on today's episode….

N2: Go on

N1: Oh that's all I had...(*laughs*)

N2: (*laughs*)

N1: So yes, science and art. Those are words that we don't often hear together.

N2: Yeah we've been taught that science and art exist on opposite planes.

N1: Right? When you mention science, people imagine a lab coat, structure, goggles, precision, gloves, the scientific method... It promotes the narrative that scientists have to be objective and have no room for creativity

N2: But the truth is, science is a creative process. When we think of things we want to solve, we create a design in our mind - about how it unfolds, and we develop ways to understand or test it by thinking creatively using the facts that we are already given.

N1: Science and art exist together on multiple planes. Science can be used as a tool for art and vice versa.

N2: Scientific concepts are like stories, which involve a lot of creative processes, and every piece of art has a story, which can come together in a formulaic fashion.

N1: But, how *exactly* are these two disciplines connected?

N2: Great question! In this mini-series, we will be uncovering this and introducing you to a number of talented people who have mastered this intersection between science and art.

N1: That's right - it's a two-parter. In this episode, we discuss how science influences art and can be used as a creative tool, and in the second part, we'll discuss ways art serves a tool to disentangle science. Stay tuned!

CTOR tag

Introductions

N2: Hey everyone, welcome back to Carry the One Radio. My name is Devika.

N1: And I'm Celia. and today we have a very special episode on science and art. Spoiler alert: they are not mutually exclusive!

N2: We have at least two examples -- today, we'll introduce you to Suba and Alex - we love 'em.

Suba: My name is Suba Subramaniam.

N2: (she/her)

Alex: My name is Alex Naka. My pronouns are he/him.

N1: They're two very different people who have managed to blend art and science in beautiful and unexpected ways.

Suba: I am artistic director of Akademi, which is a national South Asian dance organization, a national South Asian dance organization based in London.

Alex: I'm currently a bioinformatics scientist at a startup called CODA Biotherapeutics in South San Francisco.

Paths towards science + art

N1: If it isn't already obvious, their career paths couldn't be less similar. But stick with us - it all comes full circle in the end.

N2: As an artistic director with scientific training, Suba's dance projects are often the result of cross-collaborations with scientific researchers and academics, but before she started working with them, she fell in love with dance - which entered her life *way* before science.

Suba: So no. My passion for dance came entirely out of disco. So, it was always disco first before any other type of dance. So, at a really, really young age, I was always dancing at family gatherings. We have no artists in the family as such, but I was always surrounded by music. There was always something playing, and it literally ranged from Abba. I loved Abba so much, my dad bought me an Abba songbook, all the way to devotional Tamil songs that played on the radio. And also being I was born and brought up in Malaysia, so it was actually different languages. So I was always exposed to Malay songs, English songs, Tamil Carnatic music, Tamil film music, Chinese music, because I had lots of Chinese friends, and when you went to their houses, you'd hear Chinese music or when you went out to eat.

Suba: At about age seven, I insisted that my mom took me to bharatanatyam dance class...and then that's where the classical training began. I've been sort of dancing in some capacity ever since. I enjoyed the physicality of it a lot. So, I really enjoyed what it did to the body and the way that you physicalized the form. I also love the expressive element of it. So it felt that I wasn't just dancing, that I was doing more than that.

N2: Like many classical dance forms, bharatanatyam is taught in a methodical and systematic way, which means you learn things progressively - first, you start with individual steps and hand gestures and then you build from that to learn the more complex dance routines you see on stage today. In fact, it's actually not too different from learning scientific concepts in class!

Suba: At school, I went down the science route. I was really interested in the scientific process, in the thinking, in the curiosity that goes with discovery and learning and understanding the way the world works, and so I went on to do a degree in biochemistry at King's College in London.

And all the way through, I was still dancing all the way through my degree, at my dance school performing. And then after I finished my degree, I took two years out to dance, because I suddenly realized that actually this is the time for me to do this. So I then worked for various dance companies, was a dancer in education for a company.

And it was a dancer in an education post that made me realize that actually, it was teaching that I was really interested in. But I didn't want to teach dance...I was really interested in teaching science.

I then went on and did a postgraduate certificate in education, became a science teacher, and then started teaching science part time whilst dancing. And that's when I set up my very first company with another dance colleague. The company was called Angika. And we then just started to experiment with the form.

N2: So cool! Suba had quite the journey. I wonder what Alex's path was like?

N1: Well, across the pond, Alex graduated with a PhD in neuroscience from UC Berkeley, and started exploring art at the very end of grad school. His jam is something called "generative art." He'll tell us all about it in a minute, but just to get us all on the same page now: generative art is an umbrella term for an art form -- music, literature, digital art, you name it -- that is partially or fully created with an autonomous system. Like the cool patterns you see in a kaleidoscope -- they're beautiful, but created by something not entirely under the artist's control.

Alex: One of the things that actually kinda opened the door into it for me was the process of learning how to do scientific programming, which I did during my PhD studies at UC Berkeley.

Closer to what actually got me into doing generative art, versus just being a nerd...there's two things I can point to. One of them was...At some point during grad school, I went to a museum (and I cannot for the life of me remember where it was, or what museum it was), but I saw a

bunch of pieces of early generative art from the 60s and 70s.I really adored it. It's very simple and yet, striking and interesting.

The other thing I remember about it was kind of being like, "wow, this is just a few lines! I feel like I could do this." Which I think is something that, for abstract art in general, people kind of always think that. And the same thing comes up for generative art. In a lot of ways, it's true. Pretty much anybody can make this stuff if they want to.

The actual sort of jumping into things was at the end of grad school. I decided I wanted to try to learn a lot more about programming, and I was taking on a lot of practice projects. I had it in my head that I wanted to write a program that would simulate the growth of a tree, or something that looked like a tree. I was on this pretty long trip that involved a lot of long bus rides through Peru and just was playing with my laptop this entire time, toying with this thing. And at the end of it, I had stuff that looked like passable trees to me. And also, a lot of stuff that didn't look like trees, but that I still thought looked cool.

And, so, that was the first time I ever really deliberately worked on making something for no purpose other than creating some piece of art that I liked. From that seed, I've leaned into spending a lot of my free time on it.

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Details of work/process

N1: Okay, two very basic questions…

N2: Shoot.

N1: So, I get that Suba is a dancer and Alex is a scientist-slash-emerging-artist, but...what exactly do they *do?* What does this dance look like? And, how exactly does Alex *generate* his art?

N2: I had the same questions! Let's start with Suba. She is a bharatanatyam dancer - it's one of the oldest classical dance forms in India. Ballet has been around since the fifteenth century, which sounds old, right? Bharatanatyam, on the other hand, has been around since the *second* century...maybe even earlier.

Suba: I would say that it's a dance form that's incredibly sculptural. It's rooted in a codified way of learning and practicing. It is full of myths, stories, and storytelling. It is rich in gestures, and it is rich in its codification even to the level of how a classical dancer is dressed. The costume is colorful. There are flowers in the hair. But every single bit of what a classical dancer wears is

codified...it's so deeply rooted in tradition that, yeah, it's almost like watching temple sculptures come alive and move.

There is that sort of classicism within the forms, which have been there for a very, very long time - some things have changed and some things haven't. In that sense, there is similarity in terms of ballet and bharatanatyam. However, with bharatanatyam, it's just more colorful in almost every sense of the word, from stories to the form to the storytelling to the jewelry to the sculptures, to all of it. Yes, there are set stories, but the way in which the form has evolved over the years, for it to sit in a contemporary stage in a contemporary setting, it still sits, it still holds, it still is relevant in so many ways.

N2: Okay, so we know that bharatanatyam is *old, but* it's still relevant today because it's *adaptable.* Every tiny detail of gesture and movement is timeless - like using the same alphabet to create stories over hundreds of years.

Now, how about Alex's art form? It's not centuries-old, right...?

N1: Not at all -- at least as we know it now, generative art has a much more recent history, and has a lot more in common with computer science than what we might think of as "classical" art.

Alex: Generative art I would say, is art that is usually done with computers, and involves some kind of element of it being out of the artist's control. So, procedurally generated. A really important element of generative art is that it almost always involves some element of randomness.

N1: So podcasts are famously *not* a visual medium, but let me at least try to describe one of these pieces of art for you: picture a circle, with a thousand circles inside of it, drawn with robotic precision. Inside of each of those circles, there are squiggles and grids and shapes that all seem to blend together perfectly, but with a dash of chaos thrown in there. And these are *perfectly round* circles and *perfectly straight* lines -- nothing a normal person could draw by hand.

N2: Okay...but how do you make something like that?

N1: Well, it depends. Alex gets a little help from his new friend…

Alex: So I have a pen plotter. I usually just call it Robot. I'm on a first name basis with it. it's a machine for holding and manipulating a pen.

Plotter art, which is art made with pen plotters, involves a process of having a robot pick up a pen and make marks on paper. It is different than the process that most people are used to with printing something on paper, in that a printer takes a raster graphic--pretty much a grid of values like black, cyan, magenta, yellow, and says "I'm going to print this much of each color at each of

these locations on this grid." A plotter takes vectors and tells this robot holding a pen to place the pen on paper and follow the path.

Pen plotters have motors on them, right? And all they can really do is listen to instructions about what to do with their motors. The challenge with making art in this medium is that what you have to do is take the small, simple unit of marks on paper, like lines, and build that up into something bigger. A lot of the very best generative art are things that start with simple rules, like algorithms, and find ways to take those and make things emerge out of them.

Generative art involves the collision of three things, I think. Some of it is creating algorithms to do stuff. Some of it is human intervention and some of it is randomness. Another element is figuring out which parts of the thing you're making you want to be kind of like hard and fast rules, and which things you want to be random or parameterized -- in some way that gives you a knob to turn and be like, "oh, I want this to be a thing that I can change and maybe regenerate in different random ways."

Examples of recent projects

N2: That already sounds more "science-y" than I thought art would be...like, c'mon, "parameterized"? That's *peak* science vibes.

N1: Yeah! The process of creating generative art is almost like the process of creating a science experiment, from planning, to failing, to planning again, to failing again.

Alex: For me, part of the process of making this art is trying to learn how to do new things.

N1: We asked him to give an example of how you'd make something from start to finish, because, again... the final products look *nuts*. We linked his instagram and twitter accounts in the show notes so you can see, but they're these like, *incredibly* complex illustrations. Fractals and concentric shapes and the teeny-tiniest details.

N2: Like the cover of an old calculus textbook.

N1: Yeah exactly! Mathematicians love this stuff. Here's how Alex made one of these masterpieces.

Alex: I got this idea that I wanted to try to recreate a doodle that I have been doing for as long as I can remember writing stuff on paper, which is...Basically the idea is I draw a circle and then on the edge of that circle, I draw another semi circle that connects to it. And just keep layering little semi circles around this thing. At the end of it, you get something that looks a little bit like the inside of a sunflower.

One thing I want to do is figure out how I can create primitives like small shapes, like circles or squares, and handle the intersection and inclusion of them with each other. And so, the starting point for that is figuring out, okay, so how do you do this?

What I did was create an algorithm that proceeds in steps where you start with a circle, and you draw a new circle through that same process, but you make a bunch of candidate circles on there, and then you pick the one that is closest to the starting circle.

Eventually, I was like, “okay, I can recreate this doodle that I did a while ago. But what happens if I change some things in here?” So, one parameter that I might think about, making this process, is how many guesses does it get to take before it picks a new circle? If you give it many guesses to find the one circle that is closest to the center of this blob, then what you’ll end up with is something that looks like this very orderly, close packing structure, a lot like a sunflower. But if you give it only a few guesses, you get something that looks more disorderly, or organic in some ways

N1: It’s so cool that he was able to take an idea, a *doodle,* that had just been simmering in his brain forever, and turn it into real, physical art. Makes me appreciate my own doodles

N2: Absolutely - and Suba kind of does the same thing.

Suba: Usually, I have an idea, and then it sits with me for quite a long time. I have to sort of digest it before I can make something about what it is that I want to make work. I’ve been really fortunate to have a lot of different things that have inspired me.

N2: She told us about one project she made for Sadhana (one of her dance companies), which definitely pulls inspiration from all corners of her brain.

Suba: So one of the first pieces I made for Sadhana was called, The Shiver, and it was all about what makes us shiver, whether it’s through pain, through pleasure, through being cold, or just through the sheer beauty of having seen something or felt something that you can’t always articulate.

N2: This project wasn’t just informed by science, but was kind of designed to *inspire* science, too.

Suba: Trying to find different ways to engage people, young people especially, in science was something that I thought, “Actually this is really quite interesting. And, what happens if I make a work about science? Could I instill something in people to want to then be interested in the subject?”

So when I started creating work that had quite strong scientific conceptual ideas around the work, what I realized was that the idea of the art is not to teach. The idea of the art is to instill a curiosity in people.

When I started to think about science as being the thing that I wanted to create different scientific ideas or subjects of concepts, that's when I realized that dance can play a role in the public engagement of science.

N2: In the case of The Shiver, it was all about sparking curiosity about the brain and the body.

Suba: I met this wonderful neuroscientist called Professor Morten Kringelbach…(laughs)...and he's a neuroscientist. So very early on, I decided I was going to work with people with very interesting names. Doesn't always work, but I've managed a few. So Morten and I met through a talk that I did called The Creative Brain. And we both got really excited about the potential of creating a dance that had a massive neuroscience element to it. And then I commissioned a wonderful poet called Lemn Sissay, who's made a radio program called The Shiver about your body's capacity to regulate its own body temperature.

We all got together and met these amazing audiovisual artists and a lighting designer, and we all sat down, we got Morten in the room, and Morten talked us through lots and lots of different things about neuroscience, about the way our brains work, neurons, different kinds of neurons, motor neurons, and about movement and how our brains work. He showed us videos of people going through deep brain stimulation to stop pain, where he's worked with surgeons, where they stick electrodes in your head to understand this very fine line between pain and pleasure, because it's expressed in the same part of the brain.

And then I worked with three dancers with the scientists in the room. Then, in a way, what we all do is go away and express what we've heard, understood, all that research in our own art forms. The audiovisual artists are doing the same sort of thing that I'm doing with movement, that's how it all works. The costume designer is thinking in the same way that we're thinking about movement, We just work collaboratively together. Every element of it, of the work, is connected always to the idea that we started off with.

It's the journey, not the destination

N1: Love everything about that amazing collaboration! It kind of reminds me of something Alex said about parameterization (it'll make sense, I promise!). When he was talking about writing instructions for his pen plotter, he said

Alex: So, this is another element of it, is basically figuring out which parts of the thing you're making you want to be kind of like, you know, hard and fast rules and which things you want to be random or parameterized.

One of the core ideas of generative art is taking simple rules and discovering things within them. You end up with this incredible like, infinite complexity, for many of them. And I think that's what makes them very beautiful - you can sort of perceive both this elegant simplicity, and also the great depth of how much complex information is in there.

N2: In Suba's case, she allows her dancers to be that emergent property in her art.

Suba: I think about the form, and the form is a starting point. And, I would give the dancers a series of steps, and I will say that, "That is your parameter within which you work." For me, that allows you to be even more creative, if you really tighten those parameters.

And working with dancers, the thing that I love is the creativity. I would have thought of doing X with a particular step. But they would do X, Y, Zed, B, and D, and put it together, and it would look utterly beautiful. So, dancers are collaborators really in the space with me. I just direct and construct and put the piece together. But actually, the movement is created by the dancers. And, that, for me, is one of the most beautiful things to see, is the creativity that comes out of a process. For me, the process is more exciting than the thing itself sometimes.

N2: Isn't that the whole thing with Bob Ross and his paintings? Enjoying the journey? "We don't make mistakes, just happy little accidents?"

N1: It sure is! And to quote Hannah Montana circa 2009, "*It's the climb!"* And one thing Alex discovered while exploring his own art is that the process, and the mistakes that come with it, is the best part.

Alex: I'm kind of a STEM guy. Definitely. I've always thought of myself as being more "science." I'm not very art-y. And I think that a little bit of that, for me, is it can be difficult for me to be okay with doing anything if I don't feel like I'm doing it well. When I was at Berkeley, I took a few drawing classes. I have my own pretty strong internal self-critic that was telling me, you know, "this is not that good." That's part of being a beginner at stuff. But in many cases, that made it hard for me to get started with stuff.

There is a part of generative art where it's really easy to make mistakes, and it's easy to make mistakes that are very interesting. There's also an element of it that I really like, which is that, as compared to a lot of other forms of art, it tends to be less about representing reality. It's just totally abstract patterns. It's a reductionist view of art in some ways, where it's just like, what are the very simple elements that make up visual experience, and how they can be combined together in a way that looks good. That looks cool. That is beautiful, or appealing.

I found myself able to just make a lot of things, and be ruled by how I felt about how, you know, these curves and lines and simple shapes look together. Rather than did I, you know, draw that box well enough? Did I draw this figure, this person well enough? Basically, a chance to set my own definition of what's good and what's not good.

Music Break

N2: So far, we've learned about how Suba draws inspiration from science for her art form, dance. This has not only helped explain numerous scientific concepts like temperature regulation in The Shiver, but also how art ignites scientific curiosity.

N1: And Alex has talked us through his methodology to create generative art, which not only draws from a lot of math and programming, but also involves some simplicity and randomness

N1: If we haven't convinced you of this mutually beneficial relationship between science and art, let's scale back and dive into how creativity and the scientific process relate to each other

Alex: One of the things that has really drawn me to making generative art is that the creativity that you exercise in this process feels a lot like what it feels like to exercise creativity in science, which is my day job.

When I was learning about science, growing up, it was hard for me to see how it fit into things, because the scientific method looks like a rigid system for figuring things out. And I think one of my favorite things about my scientific training was learning about the ways that you *do* get to exercise creativity.

N1: Well said Alex. Sometimes it feels challenging to imagine this overlap between creativity and science, but there so many examples that date *way way* back

Alex: To take a step back, it can be sort of hard to see from the outside of science. On the one hand, people, I think, definitely associate creativity with the scientific greats of history, right? Like the apple dropping on Isaac Newton's head, and he has this little moment of inspired creativity and comes up with this totally new way of thinking about things.

There are a couple of different ways where it comes up a lot. One of them is just figuring out what is a good question to ask: what is interesting, what's important, what is knowable, what can be figured out at that moment in time. And once you have a question, there's a process of generating good hypotheses. And then finally, there's this last stage of figuring out how to test these things - designing experiments and solving problems.

As a scientist, you can think of examples like "wow, that was a really elegant way to address that problem." The trick to it is creativity within this very constrained setting. It's the cycle of defining a set of constraints, a problem to be solved, and then trying to figure it out. And then along the way, adapting and stepping back again and resetting your constraints, doing it all over again.

N1: This iterative process used in scientific discovery is *really* similar to how many art forms are developed. And it's apparent in generative art, as Alex describes...

Alex: Something that happens all the time in making generative art. You start with just a seed of an idea, and you think about different ways to do it. If you're like me, then you're going to make

a ton of mistakes along the way. But a lot of them will turn out to be very interesting-looking mistakes. And one of the things that's great about it is that if I see something that's a new, more interesting question or hypothesis to be generating ideas towards, then you can just drop what you're doing and start working towards that.

And frequently, what you end up with is little seeds of things, little new things that you can pick up and put in your toolbox and then mix together with other things down the road. It really feels a whole lot like exploring and discovering things, like they're these patterns waiting to be found that I didn't even really make myself. They were already there, and I found them.

N1: You hear it all the time! To be truly creative, you need to "toss out the rules" in order to "free your mind", but actually, when you have less to work with, you start to see the world differently...

N2: Exactly! When there are no limits to the creative process, you're more likely to fall into the path of least resistance. That is, you'll end up doing the thing that makes the most sense intuitively, and as a result, you're not really investing in the development of better ideas.

N1: Yeah, That's a really important point - constraints provide focus and a creative challenge!

Suba: What excites me the most is when the scientist tells me they think differently about the way they do stuff after having collaborated with us as artists. That's what's most interesting, because I think a lot of the time, I feel that, and I say this openly, because I'm sure I've been guilty of this too, is we, as artists, just take, take, take, take from the science to inspire us to make work. But actually, what's happening with the scientists or the academics or the people that we're working with, has it shifted anything about their practice and their process and their thinking?

N2: Seeing this mutually beneficial relationship between science and art, we were curious to see to what extent they may have influenced one another. In Suba's case, we asked if pursuing science made her a better dancer, she said...

Suba: I don't know whether it makes you better at anything. It makes you more aware of things. You get a sense of yourself, your physicality, your body, the space you move in, the way in which you move, your embodiment of things that you're trying to say. And we're trained in our form to do that, right? So if I say to some of my dancers, "Actually, I really want you to look at this fine line between pain and pleasure in that little movement section. I see the pain, but I'm not seeing the pleasure, and I'm not seeing the in-between bit. How do we embody that?" So, it makes you think slightly differently.

N2: So it does not necessarily make one better, but it expands one's perspective. That's a win in my book.

Suba: So, as a dancer, you're dancing around the things that are present and that you understand and feel and have experienced. You're embodying it possible through a lived-in

experience, but possibly not. And for my science background, as a science teacher, having the art has always been a huge bonus. It's a way in. It's just for me, an absolute way in.

For me, it's sometimes when I can't find a scientific way to explain, I might slightly go down a different route. That might be art.

Sometimes art allows a way in, in the way we think and how we process. There are so many (again, cliched) synergies in the process, right? Science is creative. If you're not creative, you can't do a whole process. You can't go from A to B without going through parts and going down one and not working, going down the other, and being creative about where the next bit is. I think science is hugely creative.

Short music clip

Social media plugs

N2: If you'd like to learn more about what Suba's working on, be sure to check out Akademi, the South Asian dance organization she currently directs in London on instagram @akademidance and twitter @akademi.

N1: And if you want to be mesmerized by videos and stills of Alex's generative art, follow Alex @gottapatchemall on twitter or @bb_bygones on instagram.…… We will include these in our show notes

N1: Beyond using science to inform art and as a creative tool, in the next part of our science and art series, we talk to two other people about ways to use art to transform our understanding of science, scientific communication, and advocacy. Stay Tuned!

Credits

This episode was produced by myself, Stella Belonwu, Celia Ford, and Devika Nair, with help from the rest of the team at Carry the One Radio. Thank you so much to Suba Subramaniam and Alex Naka for their time, and to you for listening.

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