Tom Kelley:

Okay, anybody ever do any work with BMW as a client or as an employee there? Nobody is admitting to it. Anyhow, if you work with BMW, you get behind the scenes. One of the things that they really truly believe at BMW is that a distinguishing characteristic of their drivers, of their customers, is that they are smart, that they are smarter than some other people's customers. And they have evidence to support this claim and it informs not only the features that they build into their car, but also the way they communicate their message, the way they present their brand. And wow, at first I thought, "Gee, can that be true?" But as they told the story and as I saw them roll things out, yeah, I think they have a defensible position there. And as I started looking at the speakers for this year's AIGA conference, you got Michael Conforti who you heard from this morning and hopefully everybody followed that. I had my notes from last week to refer to, which helped me a lot and I saw him last time. We got Malcolm Gladwell coming tomorrow, who I think the word "polymath" applies to. Brilliant guy, on almost any subject he focuses that beam of his attention and intelligence on.

And I know I can't say that I know him as a -- or I spoke to him as much as some of the other presenters, but this next speaker, Jonah Lehrer, looks like a likely candidate for that list. You know just for a starter, just out of the, you know, starting gate, he is a Rhodes Scholar. But in addition, you look at the -- if you read the brochure the things he has written for, he wrote for "Scientific American Mind," he worked with a Nobel Prize winner, he works for -- writes for "New Scientist" and "Nature," he appears on NPR and writes for NOVA and "MIT Technology Review." Gee, I am thinking we've got somebody who's gonna share some interesting stuff with us. Back in the green room when I was talking about some of the topics he is gonna cover and the -- it's just we were talking about one of the questions and he says, "Gee, that's a little esoteric." And I said, "Come on, it's the talk that's a little esoteric. It's called, you know, 'Proust Was a Neuroscientist.'" So listen up. I think this will be thought-provoking. I think it would be darn interesting. So please welcome Jonah Lehrer.

[Applause]

Jonah Lehrer:

Well, thank you so much for having me here. It's a real honor to be here. I will be talking about "The Future of Science is Art," or what we can learn about the brain from a 19th-century French chef and Kanye West.

I've had the pleasure of watching a few of the PowerPoint presentations backstage. I must -- I had never been so self-conscious about my PowerPoint presentation. I'm suddenly rethinking all my fonts and transitions. So I have to do it -- start the more generic PowerPoint presentation right now. But much of what I'll talk about is drawn from my book, "Proust Was a Neuroscientist," which is structured on eight case studies of artists who, at least I argue, anticipated the neuroscience of today. They came up with real tangible truths that modern science will later rediscover. I talk about everyone from Walt Whitman to Virginia Woolf, of course Proust. But the person I'm gonna talk about today is a 19th-century French chef, Auguste Escoffier. You go to any fancy French restaurant, they're -- really, any fancy restaurant, and you're essentially eating variations on his cuisine, or the cuisine he invented in late 19th-century Paris, and first outlined in his 1903 cookbook. It remains the most influential cookbook of all time. You got to any chef's rack of books and it's got the pride of place. It remains the bible for fancy cookery. And when you think about cultural forms that's right in the 20th century, it's kind of amazing. I mean there are few cultural forms that survived the 20th century intact, and yet we're still cooking fancy food the way Escoffier told us to cook. So what was his big innovation? His big innovation consisted of two main parts. The first was his emphasis on veal stock. He says right there on the very first page of his cookbook, says if you got a good stock, cooking is easy. If you got a bad stock, get out of the kitchen, you're wasting his time -- you're wasting your time. His recipe for veal stock or chicken stock or fish stock was very straightforward. You essentially take all the stuff chefs use to throw out. So, leftover veal bones, bits of meat, and tops of carrot, scraps of onion and celery, and you put that in a big stock pot with cold water and you simmer for 12 hours. What you're trying to do is extract all the meaty juice from the bones and bits of meat. So you get this very flavorful meaty broth. After 12 hours, you're now, as Escoffier says, ready to begin cooking. But that's his recipe for stock, very straightforward. That's the first central innovation of the Escoffier cuisine. The second innovation was the process of deglazing. Again, a very straightforward process, so you take meat in a pan, a hot pan, none of this nonstick stuff, and you put a little fat in and you let the piece of protein, chicken breast, filet mignon, piece of fish, and you let the piece of protein burn. So you want to get a nice seared, [inaudible] crust on it, so all those burned bits of protein are stuck to the bottom of the pan. The dishwashers are often in the corner grimacing 'cause the pan is a disaster but, you know, Escoffier didn't do the dishes, he didn't mind. So, then you flip over the piece of protein. Burn it on the other side, too. You sear it again and then you take it out. Once it's fully cooked, here is where you take your stock and take a ladle of your hot stock, add that to your pan, take your wooden spoon and scrape up all those burned bits of protein from the bottom of the pan, so they melt back into the sauce. You reduce down this stock and burned bits of protein concentration. Add half a stick of butter and voila, you've got your brown pan sauce. That's the basic French technique. It's a basic French culinary technique first pioneered by Escoffier and is still in use in any fancy kitchen today.

Now, this raises an interesting question: Why does it taste so good? What is it about Escoffier's collection of recipes that so titillates the tongue? You know Escoffier started cooking and people first started having these buttery, varnished brown sauces. It was the best food anyone had ever tasted, and you can read some of the original reviews of his restaurant in Hotel Ritz. And this is superlatives like you've never read superlatives before. I mean, it's the best food anyone has ever tasted. And the question is why. What is it about reduced veal stock and deglazing that so excites our taste buds? At first glance, you know the answer isn't obvious. When Escoffier started cooking, and this theory goes all the way back to Aristotle and Democritus and the ancient Greeks, the theory was the tongue had four and only four taste sensations. There is sweet, sour, salty and bitter. By the beginning of the 20th century when Escoffier was working in his recipe, scientists had even mapped these four taste sensations to different parts of the tongue. So, sweet was in front, bitter was in back, and sour and salty were in the sides. They'd looked at the tongue under microscopes and seen these four different taste receptors. The tongue seems solved. There was the first sensory modality that science thought it really understood. But now think about a veal stock or a chicken stock or a brown pan sauce. It's not particularly sweet or sour unless you burn the bones and Escoffier says don't burn the bones. It won't be bitter. You know, you'll have a little salt in it, but as Escoffier puts it, if you can taste the salt, if you notice the salt, you've added too much. So it is then why does it taste so good if doesn't seem to rely on any of these four canonical taste sensations? These are called the four canonical taste sensations. Then, what about veal stock makes it so delicious?

To get the answer to this question, you have to travel halfway around the world where, in 1907, a Japanese chemist named Kikunae Ikeda was eating a bowl of dashi. There is actually in the food section in "New York Times" last week, this article on dashi, which is a Japanese broth made from dried kelp and dried fish, and it's about how are these high-end chefs are now using dashi in their cuisine. It's kind of a lighter version of veal stock, in a sense. But anyway, he is eating this bowl of dashi and all of a sudden he has an epiphany. He realizes that this bowl of dashi doesn't taste sweet, sour, salty or bitter. It doesn't taste any of the four classic taste sensations and said to describe the taste of this bowl of dashi, he invents a fifth taste sensation, which he calls the taste of deliciousness or the taste of "umami." It must have been a good bowl of dashi, clearly. He then spends the next few years distilling down buckets and buckets of dashi, trying to find the secret ingredient that makes dashi so umami, so delicious. He eventually discovers that it's a form of glutamate. Glutamate is the most prevalent amino acid in life and that when this amino acid is unraveled to become L-glutamate or glutamic acid, it's converting to a form that tongue can taste and that basically replicates the sense of deliciousness. Unfortunately, glutamic acid is unstable so he binds into a salt to make the now-infamous chemical called monosodium glutamate, and finds that if you sprinkle little MSG in water, you replicate many of the aspects of deliciousness. So he is very excited about this idea. He then spends the next few years going all around the world looking to see if other foods are also high in glutamic acid or L-glutamate or umami and finds that sure enough, once you started looking, it's everywhere. It explains for example why so many cuisines, from the garum of ancient Rome to modern Vietnamese food or modern Thai food, rely on fish sauce. Well, fish sauce being rotten anchovies, a rotten fish, which are full of glutamate and when you rot them you convert the glutamate to glutamate acid. Those are very, very high in umami. Any aged cheese, when you age a cheese what you're really doing is converting the glutamate to glutamic acid, so they're all very high in umami. Parmesan cheese actually is more umami than any other cheese in the world. Marmite, that disgusting British yeast extract, that sandwich spread, that's like an umami speedball. It has more umami, it has more umami per 100 grams than any other processed food in the world. The difference in a ripe tomato and a green tomato is that a ripe tomato, because it's been ripened by the sun and all the glutamates have been converted by the UV rays into glutamic acid has much more umami than green tomato. Prosciutto... Soy sauce, why do you dip raw fish which, because it hasn't been cooked, so it's a glutamine and not glutamic acid? Why do you dip it in soy sauce which because it's fermented, it's full of glutamic acid? Well, because you crave that rush of umami and so you dip your raw fish in a umami bath.

So he's thrilled by this discovery. He thinks this is a very, very exciting idea. He has come up with this fifth taste sensation which seems to explain all sorts of weird culinary quirks. He is waiting for the call from Stockholm and his Nobel Prize to arrive, and instead he is greeted with complete and utter silence. He publishes in the middle of the obscure journals in Japan, but even a few scientists who do pay attention to his papers say, "Well, you know, maybe you explained something about Japanese food, about soy sauce, but certainly you didn't explain anything about fancy French food or veal stock or, you know, western food." So his papers are ignored for the entire 20th century. Umami gets virtually no attention. What's interesting is that food companies aren't quite sure, aren't quite so sure that he's wrong. They take MSG and start putting it in everything from Campbell soup to chicken bouillon cubes, to cheap Chinese food, add it to mixed nuts, basically anything they can think of, frozen dinners. So, MSG becomes this cheap way for food companies to inject this instant burst of deliciousness into their food. Even now where MSG has got a bad reputation probably wrongly associated with migraines and headaches and many scientists have looked and concluded for the most part that it doesn't seem to be responsible. Food companies still realize they need to sneak it in somehow, so now instead of calling them MSG, they call it sodium caseinate or hydrolyzed soy protein, or a bunch of other euphemisms but it's basically MSG. So here's -- the 20th century passes and Ikeda's science is ignored. Fast forward to -- oh, sorry. And of course, umami also explains why that's making us drool and look so delicious. When you cook a -- when you cook -- when you sear a meat, all that flesh on the outside, that's unraveled glutamate. That's pure glutamic acid and that's why they taste so delicious. Just a brief digression here, you ask most people why you sear meat in a hot pan and they say you'll seal all the juices. Well, that's completely wrong. The sound of sizzling is actually all those juices evaporating. The reason we think seared meat taste juicier is because when you see that picture, you start to drool. And so literally, and so your salivary glands open up, and so what you think is actually meat juice but it's actually just your own spit. [Audience laughter] But that's just another sign of just how good umami taste to us, that we're all drooling looking at this photo, so I will move on.

So fast-forward to the year 2000, some neuroscientists at UCSD and the University of Miami are going through the human genome and they pull out this genome, it looks like a taste receptor and they clone it and sequence it and find that, sure enough, it looks like a taste receptor, but it doesn't respond to sweet, sour, salty or bitter. So on a lark they say, "Well maybe, this guy had this crackpot theory about glutamic acid. Maybe we'll test it for that." Find that, sure enough, this taste receptor responds and only responds to the taste of umami, to the taste of glutamate. It's expressed all over the mouth and tongue. Two years later another group finds a second receptor that responds and only responds to the taste of glutamic acid. It's called the umami 2 receptor in honor of Ikeda. Many neuroscientists now believe that this is actually the most important taste sensation and that it somehow modulates the other four. It's the only taste that's sensed all by itself and not relative to the other four. In retrospect, this makes perfect sense. We're sacks of protein and water ourselves. So we're always craving an amino-acid refill. So it makes sense the tongue would learn to love what the body needs.

But I also think this helps explain, help us understand what Escoffier was up to. He called himself an intuitive chemist, but the truth of the matter is that he really didn't think much of chemists and the science of his day. He tells young chefs, "Ignore all the people telling you what to do. Taste and taste again. It's by tasting, by paying exquisite attention to your tongue that you'll figure out how it works." And that I believe is what allowed him to come up with these recipes like veal stock. Veal stock is simply umami water. And when you deglaze, all those burned bits of protein are concentrated burst of umami. When you combine the two, it's an umami flood. It's an intensity of glutamic acid and it's by paying such an exquisite attention to his tongue that allowed him to figure how the tongue works, at least in terms of this basic fifth taste sensation, which is now in all the textbooks nearly a century before science. So Escoffier discovered something else but you have to read the book for that. But I'd like to move on.

The basic strategy I use in the book time and time again is asking, "Why is this meaningful?" Why do we stare at dripped paint on a canvas? Why do we still look at Jackson Pollocks and pay so much money for them, or Mark Rothko blocks of primary color or some synthetic cubism? And the basic idea behind asking these sorts of very childish questions is that great art and design isn't an accident. It works for a reason and that by reverse-engineering the art, by trying to figure out why Jackson Pollock so excites the visual cortex or Rothko or why we're still reading "Hamlet" 500 years later, you can learn something interesting about how the brain works.

And so, I'm gonna do a quick case study to give you a sense of how you can employ this by looking at music. So the first question is: What is music? And the old theory, which we'll call the melody theory, and once again this goes all the way back to the -- Plato and Pythagoras, the ancient Greeks. He said, "Music is simply a set of pretty notes in the right sequence." Plato and Pythagoras argued that certain notes, consonant notes, vibrated in neat geometrical ratios, the sound waves looked more symmetrical, and that's what made them pretty. So music prettiness, melody, was ultimately reducible to playing these pretty sound waves, which brought "order to our soul," as Plato put it. We like consonance, we like dissonance. So it's a really elegant theory. It makes a lot of intuitive sense. Music feels pretty to us but happens to be completely wrong. People first realized the melody theory had some holes in it when they -- when anthropologists started going around the world and asking other cultures and tribes what their favorite notes were and they found that no one could agree on what consonant notes were. Everyone had a different definition of prettiness. There is even a tribe in New Zealand which thought the C-major chord, the very definition, the cliche of consonance in western music, was dissonant. So clearly, music simply wasn't a pattern of finding the right sound waves and playing them in some elaborate sequence. Something else was going on. The modern scientific theory of music, which we'll call the pattern theory and illustrated with Igor Stravinsky looking very dapper there, is called the pattern theory. And the basic idea is that music is a set of patterns and music hijacks the brain's penchant for finding patterns in reality.

But before we can get there, a very quick digression to the science of sound, how the brain hears sound, it's such a beautiful sensory system. Inside your inner ear you got thousands and thousands of hair cells between 10 or 20, 000 hair cells arranged like the keys on a piano. Each hair cell is tuned to a specific wavelength of sound. So any given moment, the sound of my voice or a symphony orchestra, all these sound waves are entering your ear and knocking over these hair cells one by one. They literally bend and when they bend like a tree in a breeze, they send a signal onto the brain saying I've heard this wavelength, I've heard this sound. Now that's a lot of information. It's like a cacophony of information for the brain, you know. At any given moment, thousands of these hair cells are telling the brain they've heard something. The question is how does the brain make sense of that? How do you take these thousands of sensory inputs and turn that into the sound of my voice or a recognizable pop song. And that's where you get to the auditory cortex, which it makes sense of the world by mining this flood of information, this cacophony of sound and all these hair cells. These hair cells are responsive to Brownian motion, which is the random jostle of atoms. So they are incredibly sensitive, which means that they are very tough to figure out and this is why patterns are so important. So, the mind searches for patterns and it deflects the notes and this is where we get back to music. There's a great book called "Emotion and Meaning in Music" by Leonard Meyer. It goes back to the '50s. I think it was in '55 when he wrote it. And his case study is he looks at a Beethoven Symphony in E Minor and he found -- and he shows you something really interesting. He shows you that Beethoven begins the song by introducing the pattern. So this is the pattern that your brain comes to expect. It's the set of notes you hum to yourself. It's the hook, the chorus, the jingle. It's all those things and he begins a song by playing the tonic chord, the tonic opening. This is the pattern he's introducing your brain to. But then Beethoven did something very interesting. He spends the next 20 minutes avoiding that pattern. He comes up close to it. He suggests it. He implies it. He makes your brain think about it but he doesn't give it to you. So he's literally making your brain search for this pattern he gave you in the beginning, and that's what makes the music so interesting. And at the end, the Hollywood happy ending comes when the tonic is replayed and the pattern returns safe and sound and you experience this sigh of relief 'cause your brain has found the pattern it's been searching for again. But so music, in a sense, is this cat-and-mouse game. It's -- It's you have to give the brain a pattern and then you've got to avoid it and you've got to come back to it in the end and that's the happy ending.

Think about it this way, if music was simply about giving your brain a pattern, then the ultimate form of music would be the C-major chord played in four-four time. Nothing is more predictable, but that's an alarm clock, not a piece of music. So clearly, there's something about giving the brain a pattern and then avoiding it and then coming back, and that's the essence of music. So we're going to illustrate that very quickly with "The Rite of Spring," which first interested me, it got my attention because it caused a riot, as I'm sure many of you know, when it was first played in May 1913 on a hot, steamy night in Paris, we don't think about the Russian ballet which this was first played out as being a dangerous thing to see. But the police were called, blood was shed. It was a messy, messy night. And the question is why. And you know, I think this returns us back to the idea of patterns. With "The Rite of Spring," Stravinsky wanted to invent a whole new kind of modern music. He wanted to take all the patterns we'd inherited from Bach and Wagner and Beethoven, put them in a blender, work them, destroy them, mix them up, and force his audience to learn something new. So, we're gonna listen to a quick snippet of "The Augurs of Spring," which is the -- about two minutes in, and that's actually what caused the audience to get out of their seats and start hitting each other with canes and throwing stuff at the stage. So it's, you know, hopefully you don't have any canes in the audience. But I think what we should listen for is how Stravinsky deliberately destabilizes the patterns you think -- the patterns your brain is trying to find in the music. So, "The Augurs" are defined by this extra staccato punctuation, and lots of musicologists have spent lots of time and ink trying to find the pattern that kind of weaves these punctuating beats together, the "oompf" together and they have concluded that the secret is that there is no secret, that Stravinsky managed to find a punctuating set of beats to which -- you know, that it's completely unpredictable. I have listened to the snippet hundreds of times and I still get it wrong. You watch me try to kind of come in with the music and you'll watch, you know, I'm like the cliche of a white guy dancing. So we're gonna listen to that now and hopefully it won't be too loud but --

[Music]

So that's the punctuating beat, and it's very tough to predict when it'll come in next.

[Music]

So, we don't have to listen to the whole thing, you get the idea. He deliberately destabilizes your brain as it searches for patterns amidst these notes. He takes all the patterns you've come to expect when you go to the Russian ballet or hear a piece of classical music and say, "You know, I'm not giving that Muzak anymore, that nice easy melody. I'm gonna make you learn new melodies that I'm force-feeding to you right now." And that made his audience so upset and we'll get back in a bit to why his audience got so upset that they literally rioted and forced the symphony to stop playing, the symphony orchestra to stop playing. But something very interesting happened after "The Rite of Spring" caused this riot. Nine months later when it was played again, this time instead of rioting, the audience carry Stravinsky out on their shoulders. This time, the symphony was being held as a modern masterpiece. Within a few years, it's already being played all across the world and being celebrated as this classic work of modernism, just a young piece of music. By 1940, "The Rite" was part of the soundtrack to "Fantasia." So you have this work of art going less than 30 years from causing a riot among the bourgeoisie in Paris to being suitable for children. So the question is: how does that happen, how does a work of art make that transition from being so abrasive that it causes people to hit each other on the heads with canes to being part of a Walt Disney cartoon?

And the answer to that question gets back to the auditory cortex and in particular the set of cells called the corticofugal network, and these set of cells, they're mostly studied in bats, has one very interesting property. So when you play, these set of cells, they're mostly dopamine neurons. When you play them a set of sounds they've never heard before, at first these cells gets very confused and they omit what's called the prediction-error signal which is the brain's way of saying, "I don't like this, I don't know what's going on, I can't predict what note is coming next, I can't make sense of it, it just sounds like noise, please turn it off." So it's called the prediction-error signal and because dopamine is involved with emotion, it's a very unpleasant felling. And so it causes you to do things like throw stuff at the stage. That's prediction-error signal, but it's the brain's way of saying, "Stop it, this is just terrible, this is -- the stuff kids listen to nowadays is just awful. Turn it off." But something very interesting happens when you play these cells that the same set of sounds, this cacophony, a few more times. The cells learn to find the patterns in it. They actually readjust their cellular connections and all of a sudden they're able to predict what note will come next. They're able to take this noise and turn it into music. And that, I believe, is what happened with "The Rite of Spring," that it was a work of art so engineered with immaculate patterns, you know, all new patterns not the patterns we'd come to expect at the Russian ballet, but new patterns, that at first it was so jarring. You know, it was so jarring and ugly and hideous. But then over time the brain learned to find the beauty in this music and that's why "The Rite of Spring" is now such a classic piece of music.

So one of the interesting things I like about looking at art through the prism of science is you find all sorts of unexpected connections. You know, we're gonna listen to Kanye West. This is a track from his latest album, and you'll see that Kanye West uses the same bag of tricks as Beethoven or Stravinsky or Wagner or Bach, that like all these other guys, he gives your brain a pattern. He says here's the hook, here's what you will listen for, and then he avoids it. He deliberately avoids this pattern and injects some uncertainty into music to keep your brain interested, and at the end the pattern returns safe and sound. But this is a track from "Graduation" and what I want you to listen for is, you know, he introduces this sample that -- Kanye West is famous for his samples. It's a two-second snippet of Laura Nyro and then he repeats that sample about -- I think the first time is ten times, and then the sample stops abruptly. All of a sudden your brain is confused. What happened to this pattern I'd just come to expect? And the pattern returns a few seconds later and this time it repeats nine times and then it stops, and this time -- and it comes back and this time it repeats 12 times and then stops and comes back again and that's seven times. But the point is your brain never knows when the pattern is gonna stop and start. The music is engineered deliberately with uncertainty and a little bit of chaos just to keep your brain interested. So listen to this sample right now.

[Music]

So that's the pattern right there and it's repeating and he is looping the pattern. He is kind of doing this into your head. Here is the pattern.

[Music]

And then it stops, and now it returns, and we won't look through the whole track but you have to take my word for it. That pattern is constantly stopping and starting and it's that uncertainty that gives the music its momentum. It gives the music its acceleration, that makes it so interesting to the brain. If the pattern was there the entire time, if Kanye West was in the same bag of tricks as Beethoven, it would be a much less interesting track to listen to. But, of course, we've all heard Kanye West and hip hop, it's not so abrasive, you know, it's not gonna make people riot anymore. So, to give you a sense of what the audience may have experienced in May 1913 when the brain is completely confronted by something you just can't understand, a stimulus that is just so confusing, so full of indecipherable patterns, I'm gonna play you a track by Girl Talk. He's a mash-up artist who I'm always afraid he's jumped the shark at this point 'cause he's been written up in the "New York Times" art section a few times. But he -- if Kanye West takes one or two samples per track, Girl Talk will take 10 or 12 or 20 and mash them all together and the end result is just sensory overload. I have listened to this track many times and I still -- and my brain still can't figure it out. My dopamine neurons and my corticofugal network are still emitting this prediction-error signal saying, "Quick, turn it off." So you'll all get to experience that pleasurable feeling right now. So please don't throw stuff at the stage. But what would you listen for is -- feel that kind of -- it's a pretty negative feeling. It's a very frustrating feeling. It's a feeling of your brain, you know, emitting what a neuroscientist call the prediction-error signal. These dopamine neurons are saying, "I can't make sense of this. It's just noise."

[Music]

So you get the idea. I mean it's not the most pleasant piece of music and my younger sister loves this. She loves dancing to Girl Talk, but I feel like my corticofugal network has been hardened and I just -- it can't make sense of it. So, just a quick gloss at the end on some of the larger themes in my book. Neuroscience right now is a very hot science but it's also, you know, it's a reductionist science, and what that means is that it tries to understand the brain, the most complex object in the known universe, by breaking the brain apart. So "you" don't actually exist. You're not a self-conscious person. You're just a loom of kinase enzymes and pyramidal cells and electrical neurons and squirts of neurotransmitter. And in one sense, that's great, that's very important. It's an essential way of looking at the brain. But my idea is that maybe the mind is like music. So you take a Beethoven symphony and you try to reduce that to its simplest set of parts and what you're left with is the physics of sound waves and you can reduce the Beethoven symphony to the physics of sound waves. Now that's interesting. You've learned something interesting about sound waves and Beethoven, but in the process of making that reduction, you've also missed everything that makes music, music. You've missed the beauty, the melody, the emotion in the notes. And so in this sense, if the mind is like music, you know, while neuroscience can actually -- can accurately describe our brain in terms of its material facts, it can reduce this to this long list of ingredients, this isn't how we experience the world. The truth of the matter is that we feel like the ghost and not like the machine and wonder -- you know, I think the ironies of modern neuroscience is that, in the end, it's able to describe -- you know, the one reality you can't describe this reality of "this here and now," the subjective, the first-person view of everything, is the only reality we'll ever know.

And this why we need art and design. Artists and designers are, like Escoffier, in touch with the experience and the reality we actually live in everyday. I always love the W. H. Auden quote: "The purpose of art is to keep reality on the agenda." I'm just gonna end with this Noam Chomsky quote: "it's quite possible -- overwhelmingly probable, one might guess -- that we will always learn more about human life and personality from novels and art than from scientific psychology." Thank you very much for listening. It's a pleasure to be here.

[Applause]

Tom Kelley:

Well, that was really fun.

Jonah Lehrer:

Esoteric, esoteric.

Tom Kelley:

Yes, esoteric. No, you did not disappoint. We had an expectation when you took the stage and you lived up to it in a big way. So okay, so call me old-fashioned but let me see. I think the talk was called, it had the word "Proust" in it, I remember, "Proust Was a Neuroscientist." Now, I did -- I confess I had a side conversation for about a minute and a half during your talk and stuff like that -- but did Proust come up within like -- if you listen to every word?

Jonah Lehrer:

Not so much. He's a tough subject after lunch, I found.

Tom Kelley:

Oh, okay.

Jonah Lehrer:

You tend to get the people with the droopy eyelids.

Tom Kelley:

Can you tell us, just give us the poet's version of the Proust story.

Jonah Lehrer:

The Cliffs Notes of what Proust discovered. Well, I mean the first thing Proust discovered -- and I got the idea for the book, I was working at neuroscience lab at that time and the lab was studying the chemistry of memory and there's lot of downtime in the scientific process. So, while I was waiting for my experiments to finish, I would bring in novels, and one day I brought in "Swann's Way," the first volume of Proust. And the first thing that struck me about reading Proust and what he was so, you know -- his insights about modern memory were the cliched Proustian moment. He is eating the madeleine, this French cookie, and he dipped the cookie in the tea and then all of a sudden all his childhood memories has come flooding back to him. And he's got a few lines in there which really struck me as -- impressions, where he says it's by taste and smell alone that the memories came flooding back. And he had seen the madeleines many times in patisseries all across Paris and never remembered anything. It wasn't until he put the cookie in his mouth, and that's actually neurologically true that the sense of smell and taste are the only senses directly connected to the hippocampus, which is the center of long-term memory. All your other senses first go to the thalamus and then go to the memory center. So your sense of smell and taste really are uniquely nostalgic. That's one of the Proustian insights, but his big insight was really about how dishonest our memories are, which is a very hot idea in neuroscience right now. That every time you remember a memory, you essentially recreate that memory from scratch. So that's got big implications for everything from eye-witness testimonies to just the way we think about our own childhood memories, that to remember our memory is to warp it and change it.

Tom Kelley:

Well, so -- You know I -- Sorry. I see a lot of films. I see 200 movies a year and so movies are the lens for which I view everything and I don't suppose you've seen a movie called "Ratatouille."

Jonah Lehrer:

I'm a big fan.

Tom Kelley:

Okay, so there's that moment when the critic who has been a jerk the whole movie takes the bite of the ratatouille and he's like, projectile-shot back into his childhood. So that's kind of what you're describing.

Jonah Lehrer:

Proust would have loved it. And one of the ironies is it's those memories that we think we've forgotten, the memories that we haven't told a thousand times, as Proust put it, those are our most honest memories because we haven't been distorting them by telling them over and over at cocktail parties. So those childhood memories that we think we've forgotten are the most honest ones.

Tom Kelley:

And I confess I haven't read the book, but I understand. My friends tell me, there's a piece about Cezanne who I think most of us studied in Artistry 101. You were talking about the Cezanne connection?

Jonah Lehrer:

One of the things that struck me about Cezanne is I'm especially in love with his late watercolors and his late canvases, which are mostly empty space. And when Cezanne was first painting these canvases, people say "Paul, it's not finished. It's mostly blank." And he said, "No, no, no, it's all there. You just have to look." And that's you know -- and one of my favorite canvases is one of his "Mountains in Provence," and it's literally five brushstrokes and the mountain is just a silhouette of gray and then there are few brushstrokes of brown in the foreground, which stand in for these vineyards and olive groves. And the miracle of the painting is that you can still see everything, that if you look at these five brushstrokes and suddenly your brain is able to film the scene and you know what he is painting. It's really nonsense. If you look literally at the painting it's just five jagged lines and yet your brain seamlessly fills in, it gives the entire Provencal landscape and that's a big theme of modern neuroscience, which is just that's what we do everyday all the time. Each of us has a big blind spot, a big hole in our field of vision where the optic nerve connects the retina, and yet, of course, we're all blind to our own blind spot because the brain seamlessly fills in that void in reality. And so, you know, if 50 years ago people thought the brain saw is like a camera, that it simply had photons enter the eye and then we develop these photons and vision is very -- now we know that vision is much more top down than bottom up, that we're always imposing forms onto reality, seeing, you know, things, like, things we take for granted, like color and depth perception, those are things we kind of imagine and then impose onto the visual world.

Tom Kelley:

So in a social contract of a situation like this, it is the speaker's responsibility to share ideas and frameworks and bring new concepts to the table, and it remains the audiences' responsibility to try to adapt or shape or translate those new ideas, those fresh ideas into their world. And I hear people out there doing that with your material but can you help us a little? Can you -- you did get to design on the fourth bullet of the last slide but -- could you, you know what -- 'cause you know this material much more deeply than we do.

Jonah Lehrer:

Yeah.

Tom Kelley:

This group knows design probably more than you or I, but can you mush them together a little bit?

Jonah Lehrer:

I think in a sense, Stravinsky is a metaphor for how you have to go about making design, in the sense of if it's too predictable, it's not new enough, it's boring it's instantly forgotten. Nietzsche has got a line about how to be remembered, something has to be burned to memories, it's got to hurt a bit. And, you know, I think in that sense music is a metaphor for every sense. That every designer has to walk a tightrope between innovation and at the same time giving the audience some kind of patterns to cling to. Back in the height of modernism it may have been cool to cause a riot. You probably won't get paid if you cause a riot nowadays. So you got to walk this tightrope between generating enough prediction error that the brains wants to listen, putting enough uncertainty, enough newness in there where the audience wants to kind of pay attention and at the same time giving enough patterns to hang onto. So that is the general design principle, which I think most designers know intuitively, but I think neuroscience is finally catching up and saying, "Here we'd found the cells which actually, you have to kind of titillate in just the right way."

Tom Kelley:

And one thing you haven't touched on yet which I think is intensely of interest to this audience is the work you did in the August issue of "The New Yorker" on the anatomy of an insight, because you know -- you go through the creative process, understanding that a little more would be quite valuable to us. So you wanna talk about that a bit?

Jonah Lehrer:

I mean that's -- it's always been a psychological moment that has always fascinated me. It's a very mysterious thing. All of a sudden you're thinking about something else, taking a warm shower and then the answer pops into your brain out of nowhere and as soon as you experience this insight, this epiphany, you know it's right. And the question is: What happens in your brain when you're having that "aha!" moment? And there's a guy at Northwestern, Mark Jung Beeman, who has done a lot of really great work studying the anatomy of an insight. He's got a great experimental paradigm where he uses word games and he does this in a brain scanner. So if I give you guys three words, you have to think of the word that connects these three words. So let me think: pine, crab and tree. So what's the third word that connects those three other words? He gives people 15 to 30 seconds. Are there any answers?

[Inaudible audience answer]

Exactly, so there are two ways to go about solving this problem. You can either go, "pine" -- think methodically through, but what happens about 60 percent of the time is people just go right away. It just, you know, "apple" pops into their head. It's an "aha!" moment, a very minor, banal "aha!" moment but it's an "aha!" moment. And this allows him to study what happens. And I think one of the big, surprising things he's found is that, for a long time neuroscientists and psychologists have been kind of pooh-poohing the whole right-brain-left-brain idea, it's such a pop-culture cliche, but he's found that insights are actually really a phenomena of the right hemisphere. What happens is, in order to have these insights you have to be more relaxed. That when you're really focused on a task and you drank too much coffee, your left brain is turned on. That's very good at kind of cranking through equations and focusing. But when you have to make these disparate connections which define the insight process, you have to kind of tune out, take a warm shower, and relax a bit and lapse into your right-hemisphere mode of thinking. And that's why so many insights happen in warm showers or when you're drowsing in the morning at five o'clock and lying in bed. That's when your brain is really in right-hemisphere mode. I think one of the surprising things is many people will take drugs, amphetamines and drink lots of coffee to stay more alert and focused. But that, you know -- this research suggests that that actually interferes with the insight process. So what you should really do is take a long walk, is do something that relaxes you a bit so you can kind of lapse into that right-hemisphere mode of thought. He has actually shown that, sure enough, neurons in the right hemisphere are what's called "more broadly tuned." So they've got fewer connections but their connections are to neurons is farther away. And so, he's actually traced down the insight process which involves making very distant connections to the actual cellular level and found that you can actually see why these cells are so good at finding insights.

Tom Kelley:

Wow. So basically you're saying for designers who --everybody has got deadlines and things like that but you're still --

Jonah Lehrer:

Take a walk.

Tom Kelley:

You can still find time to daydream a little bit.

Jonah Lehrer:

Yeah.

Tom Kelley:

To disengage.

Jonah Lehrer:

I mean, that's an essential process, you know, and daydreaming is a very hot topic in neuroscience now, too. For a long time it was pooh-poohed. It's so unproductive, you're daydreaming. But now I think people are realizing that daydreaming -- it's actually called the default system. That's the system you use when you're daydreaming. So it's an essential part of thinking and cognition. It's kind of your brain dredging up all these connections from its subterranean underworld and seeing what fits. And so it's essential, I think. I think if there's one piece of advice neuroscience can give people who want to have an insight, it's don't drink that extra cup of coffee. Don't take Ritalin. Instead, go for a walk, take a warm shower.

Tom Kelley:

And so I sit on the plane with my, you know, Bose headphones on, listening to the iPod. Is that interfering with this putting my brain in neutral?

Jonah Lehrer:

No, I mean lots of things let you lapse into right hemisphere mode, just use anything that you find relaxing. You know I think one -- one scientist I talked to, John Kounios, he said before he did this research, he never -- he thought the thoughts he'd have at 5:30 in the morning lying bed were useless, kind of dreamy thoughts, and he never -- instead he just got up and took a shower. So now when he's trying to -- kind of starting with a really tough problem, he force himself to pay attention to those thoughts, to really kind of cultivate that right-hemisphere mode of thinking that we can't help but think that way at 5:30 in the morning 'cause we're still half asleep. But those thoughts shouldn't be thrown away. What's important to do is to direct those thoughts towards the problem you're struggling with.

Tom Kelley:

Great. Thank you very much, Jonah.

Jonah Lehrer:

Thank you.

[Applause]