The Tim Ferriss Show Transcripts
Episode 83: Adam Gazzaley
Show notes and links at tim.blog/podcast

Tim Ferriss: Hello, you sexy minxes. This is Tim Ferriss, and welcome to another episodes of The Tim Ferriss Show, where my job is to attempt to deconstruct world-class performers. I interview the best of the best, whether they be chess prodigies, hedge fund managers, billionaire startup investors, actors, politicians, special ops operatives and generals, and everything in between.

What I try to do is tease out the routines, the habits, the first 60 minutes of their day, favorite books, all the tools and tricks that you can apply to your own life to emulate and hopefully replicate a lot of their success. And this episode is by popular demand. Many of you have asked for more scientists, especially more unorthodox scientists. And you've enjoyed past episodes with Dr. Peter Attia, Dr. Rhonda Patrick, among others. Those were very popular.

And today I bring you Adam Gazzaley. Adam Gazzaley has been requested by name, and now you have him. So: Gazzaley, the Gazz-monster, the Gazz-man. No one calls him any of those things, but he's a buddy of mine. Dr. Adam Gazzaley got his MD and PhD in neuroscience at the Mount Sinai School of Medicine in New York, then did his postdoc training in cognitive neuroscience at UC Berkeley. Now he's the director of the Gazzaley Lab at UC San Francisco, which is a cognitive neuroscience lab.

And I've spent time in the lab with things stuck to my scalp, getting zapped, as a subject, but also as an experimenter, a very notice data-gatherer. And I thank Adam for letting me bumble my way through that.

Adam has a very unique research approach. In his lab, they use a powerful combination of tools that are very often used in isolation, but in his lab, they're combined. So that includes fMRI, EEG, and transcranial magnetic and electrical stimulation. Now, the last category, the stimulation, has become a hot subject because you have people saying first-person shooter games where they're taking a 9-volt battery equivalent in charge and applying it to their scalps to improve accuracy. It's trippy stuff.

And, to start with, his research using these tools and other has expanded our understanding of the alterations in the brain that lead to age-related cognitive decline. But that's not enough, obviously, for me. Most important, or most interesting, to me, his recent work goes far beyond description.

He and his lab are exploring neuroplasticity and how we can optimize our cognitive abilities, even if we're healthy, via engagement with custom-designed video games. And, of course, then that leads to the question: what happens when you combine these games with neurofeedback, electrical stimulation, or even performance-enhancing drugs. What about using all of them at once? Well, that's just one of the things that we cover in this conversation, which is very wide-ranging. And it gets dense in a few areas. Bear with it. Listen. You will pick up a lot.

But we also talk about how he came to be as good at what he does as he is. That was a hell of a sentence. And his routines. All the things that he does to bolster a world-class operation and world-class performance. So, without further ado, please enjoy Adam Gazzaley.

Adam, sir, welcome to the show.

Adam Gazzaley: Thank you very much.

Tim Ferriss: So I am stoked to be in this beautiful office. I've been in the cave all day. You have more sunlight in your office and lab. We're here at UCSF.

And the name of the lab is?

Adam Gazzaley: Gazzaley lab.

Tim Ferriss: Of course. Very well-named. And I've had my brain shocked here. I have, I suppose, participated in shocking other brains, to use a scientific term. And you have parallettes under your desk.

Adam Gazzaley: Yes, I do.

Tim Ferriss: For working out. And I have just found your entire career so fascinating. We've spent a lot of time together. And I wanted to have you on the show to just explain all the nooks and crannies of this multifaceted life you've designed for yourself. And I thought we could start with: of course, you're very good at hosting parties,

so when you're at such a party, your own party or otherwise, if somebody asks you "What do you do?" how do you answer that.

Adam Gazzaley: It's not an easy question at a party, but I definitely get asked that one. I usually start by saying I'm a neurologist and a neuroscientist because it sort of lays the framework for my perspective.

But if I have to get into a very short answer, then I dive right into the fact that my lab is interested in pursuing how we can enhance cognition to improve quality of life.

Tim Ferriss: And you have a magazine cover outside of this lab on the wall, and that is *Nature*. And you have work that is the cover story. What is that work? What is the tagline on the cover?

Adam Gazzaley: *Nature* was kind enough to put the title "Game Changer" on the cover of the journal, which is quite a favorable pun for our lab, I would say.

Tim Ferriss: And the game itself? So that is a reference to – I guess it was NeuroRacer in this case?

Adam Gazzaley: Yeah.

Tim Ferriss: And why was that such a game changer in their mind?

Adam Gazzaley: Well, that's a good question.

I think that what that paper was able to show that had not really been documented well before was that a team of scientists could work with video game professionals to build something customized that targets a process in the brain that's deficient in a certain population. In this case, it was older adults and their cognitive control abilities.

And then, after you build that game, you can go through a careful placebo-controlled study with neural measure to document the mechanisms of the effect and show that you can create sustainable and meaningful changes in the brain using a video game.

Tim Ferriss: So the aspect that I found most fascinating is the sustained part. If we're looking at using very simple video games – but video games that can be made quite sexy – to reverse or mitigate the cognitive decline associated with the progression of age, what did you see in terms of the persistence of effect?

Did they have to do it every day or they just fell off a cliff?

Adam Gazzaley: Well, that was actually one of the most surprising findings of this study. So, it took us a year to build the video game. We worked with friends of mine that were professional video game designers and engineers and artists at LucasArts back in 2008. So after a year of development, it took us five years to do the study, which involved looking at lifespan changes from 20 to 80 years old, and using the game as a therapeutic to improve cognition.

Our study involved one month of game play by older adults, healthy 60 to 80-year-olds around the Bay Area. And they would play it for one hour a day, three days a week, for four weeks. And then we looked before and after at what changed in terms of their cognitive abilities and what changed in their brain. Around six months or so, I realized, "Wow. We should at least bring these folks back and see what's going on."

Tim Ferriss: As a follow-up.

Adam Gazzaley: As a follow-up. It wasn't really planned or funded in the study.

But we saw such profound changes in this group a month later that we just wanted to take a peek.

So we took these laptops back from them. Many of them were upset to have lost access to the game, which is pretty funny, because they were pretty much all technically non-savvy, to say the least, before they started playing. And they get really good at the game and they feel a connection with it.

So they haven't played the game in six months. We bring them back. And we just had them play the game again. And what we found, shockingly enough, was that their ability to multitask on this game, which is a notoriously challenging activity for older adults, as we've documented in dozens of papers over the years –

Tim Ferriss: Not to interrupt –

Adam Gazzaley: Sure.

Tim Ferriss: When we say "older," when does that start to – is it like at 30-plus you just start to lose, incrementally, this ability?

Adam Gazzaley: Well, traditionally we tended to think of "older" as 65. And then it was 60 and then it was 50. Now, from my perspective, "older" is being older than 23 years old.

Because when we look at cognitive abilities, especially these very fluid control abilities – processing speed, working memory, attention – we find that you pretty much decline from 23 on. But in this particular study – usually when you're just doing a comparison between age groups, you tend to go for 20-year-olds compared to 60-year-olds to sort of maximize those effects if you only have limited funding and you can't do the entire lifespan.

So we were pretty surprised to see that their ability to multitask in this game, in this 3D environment, had not declined 6 months later, even though it was very deficient prior to training, reached levels of 20-year-olds after a month of training, and then preserved at the 20-year-old level for 6 months. Had we known that, we would've done a lot more detailed study to see what other skills persisted. And in our current studies we're doing that. We're very focused on the follow-up and to see this sustainability. What does it mean? What causes it? It's definitely very exciting.

Tim Ferriss: It's so amazing to me.

Because it brings up all sorts of interesting questions. And you're the master at formulating these questions. And you're also, I think, a master at not fooling yourself, right? As a scientist, you have to really question your assumptions and look for alternate explanations for what you think is happening.

But I remember just before we started recording we were talking about Arnold Schwarzenegger and how anxious I was before interviewing him. But when I asked him about transcendental meditation what I thought was so fascinating is he said that he embraced TM, did it on a daily basis for something like a year, and then felt, even years later, that the effects had persisted. And if that is the case, there are many different ways you could explain it. But if you're, let's say, trying to tie it together with NeuroRacer and other tools, what are the theories or the plausible explanations? Is it some type of plasticity change?

Is there a biochemical element? What are the possible explanations for that, or mechanisms?

Adam Gazzaley: I would say that there are two main mechanisms for sustainability effects such as we found in our study and other people have

observed in their lives. And one is what you just described: plasticity. So our brains are plastic, meaning that they modify at every single level, from structure to chemistry to physiology, all in response to interactions with the environment. It's the very basis of all learning. And plastic changes, when they occur in a deep way and involve all those multiple levels of change, can last for quite a long time. So it's possible that the changes were deep enough that the system just reached a new homeostasis.

In addition to our brain being plastic, it also has a great deal of stability as well. It just doesn't change very easily. That would be very dangerous and detrimental. So it's possible that it's been moved into a new, more optimal state, and then that state preserved just because the plastic changes were so profound.

Another possibility which is interesting, and I don't think any less interesting, but a different one, is that you engage in training that's very different that then moves your brain into a different state and a different set of abilities that you didn't have before. It's possible that because of that, you have now modified your behavior and how you interact with the environment, and that new manner of interaction is what leads to the sustainability.

Tim Ferriss: So what would be an example of that?

Adam Gazzaley: Here's a sort of low-ball example, not so complicated. Let's say you go to the gym for a couple months and you get some benefit. Now no one really thinks that if you stop working out for a year that that benefit will maintain. Right? We've got a pretty good idea that you do need to keep sustained physical activity to see a benefit. So you stopped going to the gym because you moved and the gym's no longer accessible for whatever reason.

You let your membership run out. But then, because you're feeling more empowered by being more in shape, you start taking the stairs and not the elevator. And so there's an example, a sort of obvious one, of a change that you made in your life, a behavioral change. In response to the training, right? It was caused by the training. But that change in your life then leads to the sustainability of those effects, not because of the direct effects, but because you continue to exercise them in a different way than you were trained on.

Tim Ferriss: Which is very common, right? For instance, if you're looking at behavioral change and you want to get someone to change your diet but you're disallowed from saying "Change your diet," get

them to start exercising, and they will start being more conscious of health-related decisions across the entire spectrum of their activities.

Adam Gazzaley: It's what we always hope happens, right? Because that really has profound effects and reverberates. And you get this cascade of beneficial effects that feed on each other.

So it was caused by the training program, but the sustainability of it is caused by the behavioral influences that that training program has that then allows you to maintain.

Tim Ferriss: And the *Nature* magazine – I suppose it would be better called a journal?

Adam Gazzaley: Yeah. It's a journal.

Tim Ferriss: Yeah. With a very nice glossy cover on it.

Adam Gazzaley: Well, yeah. There's two top general science journals in the world: *Nature* and *Science*, *Nature* being one of them, and not publishing a ton of papers on video games.

Tim Ferriss: As I understand it – and please correct me if I'm wrong – having the cover of *Nature* is kind of like, in the business world, walking into the airport on the way to your gate, and your face is on the cover of every business magazine. Because there are dozens and dozens of business magazines, but, like you said, there are kind of two big players in this space. How did that feel when it was 100 percent, and you were no longer worried about bad juju and jinxing yourself, when –

that day came when you knew it was 100 percent you were going to have the cover of that magazine?

Adam Gazzaley: It was definitely ecstasy.

Tim Ferriss: Where were you? When did it really – when you were like, "Okay, now it's 100 percent?"

Adam Gazzaley: I was not in a very glamorous location: sitting in front of my computer, checking email, of course, is the way I found out. It's not like someone drops in on a parachute with a –

Tim Ferriss: Gives you a golden ticket?

Adam Gazzaley: Exactly. It's not quite dramatic. But it was incredible because you spend your whole life – I did an MD and a PhD, and I was in school for 18 years after high school, and just a long pathway. And then build a research program, create a lab, do a very risky study that most people thought was crazy – building a video game to rewire brains of older adults – and go through all those stages. And then just the act of getting published is just incredibly grueling. And then to obviously go all the way to being accepted into *Nature* and then the cover – it's just a very drawn out, painful process.

So when it ends, like you said, in one moment where it's there, it's absolutely thrilling.

Tim Ferriss: And the risk that you mentioned I think is an interesting topic to explore with you. Because you've crafted – from my perspective as an outsider, but also from the perspective of PhDs who have worked with you, Darya, for instance – a very unorthodox setup here for yourself. What gave you the confidence to build the game and tackle that, despite the perception by many people that it was a very risky thing to do? What was the internal self-talk? What allowed you to do it?

Adam Gazzaley: Mostly it made sense to me. To me, it was a logical approach. We've been building up confidence in the video game genre in general as being able to transform or to have an influence on behavior.

Our research had pointed to it in many directions that this was possible. And, to me, it just seemed that it was time that we challenged the system, not step in the footsteps of everyone that went before us. Much of the field looks at molecular approaches, pharmaceuticals. And I was incredibly excited, as everyone is, about all the innovation in the tech world. And to be able to bridge that with neuroscience for health outcomes just seemed incredibly exciting. And I've never really been too afraid of doing things like that, of stepping out when it seems risky.

Tim Ferriss: Why is that? Do you define risk differently from other scientists? Or is it from experiences you've had that other scientists haven't? Because when looked at amorphously, it's a risk-averse community, it would seem, in a lot of senses.

Adam Gazzaley: I think that we were sort of trained to travel through our scientific careers in a very iterative process. You know, you build on the discoveries that came immediately before you, and you advance them. And that's not really how I want to do science. I want to do

fundamental breakthroughs, if possible. And so if you have that mindset, if that's how you challenge yourself, that that's what you want to do with your life, with your small amount of time that you have here to make a difference, then the only way to do it is to do the type of research that other people would think of as risky or even foolhardy. That's just part of the game.

Tim Ferriss: Which historical figure, in science or elsewhere, do you most admire?

Adam Gazzaley: Well, I could tell you who I was most inspired by.

Tim Ferriss: Go for it.

Adam Gazzaley: When I was a kid, I didn't grow up with science or medicine in my life. I grew up in Queens. My parents didn't go to college. No one in my family did.

And they were very academic-supportive of me as a kid, but I just didn't have that influence. And I was watching Carl Sagan's *Cosmos* series. And I know it's a pretty common one because I've heard other people. But it was a really powerful, just friendly way of being introduced to the complexities and wonders, that was gripping to me as a kid. And I watched it with my dad. It was great bonding for us. The way he delivered it was just captivating, and it was really what sort of sealed the deal for me that I wanted to be a scientist.

Tim Ferriss: When you decided you wanted to be a scientist, was it just "A scientist"? Or was there an area that you thought you wanted to explore?

Adam Gazzaley: I decided somehow that I wanted to be a scientist at age seven before I actually knew what that meant. But I think I was largely very stubborn, and so if someone asked me, "What do you want to be when you grow up?" I'd say "A scientist." And I kept saying that my entire life. And maybe that's why I'm a scientist now.

At some point – it was probably around when I was exposed to *Cosmos* – I thought I wanted to be an astronomer, something in that space; whether it was more on the physics side or astronaut side, I didn't really know. But I was really captivated with the cosmos. And it was missing something for me that I didn't know until I discovered the brain and neuroscience research, which was when I was an undergraduate, so not really all that young.

Tim Ferriss: Where did you do your undergraduate?

Adam Gazzaley: I was in Upstate New York at Binghamton University. And I was a biochemistry major taking one of the very few non-science classes that I was required to take. I feel like if I could go back, I'd take all humanities classes. But at that time, I had a pretty heavy science schedule. This class was called History of the Future.

Tim Ferriss: That's an amazing title.

Adam Gazzaley: It's an amazing title, and it was an amazing class because it really tried to capture lessons from our past that guide how we view the future.

And one of the other elements of the class was to see movies like *Soylent Green* and *Planet of the Apes*. It was just amazing. And this was obviously a very popular class. And one of the lessons was on the future of the brain, and nanotechnology and the brain. And I had not really thought about the brain. And I literally immediately went to the library the next day and took out like 40 books, 20 at a time, just carrying them back to my room. And I felt like that same immense excitement as when I first discovered *Cosmos* and astronomy, but in a much more profound way because it was more connected with people and humanity, and that's what I felt missing: that space was looking out and this was looking in. And so, at that moment, I knew that I was going to spend the rest of my life on it. And now it's 30 years later.

Tim Ferriss: What does that excitement feel like?

Because it's very different from the excitement that you would feel if you just drank too much coffee, right? I would imagine. For you, what does that feel like when you're like, "Oh, I think I'm about – this is the precipice or the springboard"?

Adam Gazzaley: I think it's what people feel when they describe having an epiphany, you know? It's a transformational feeling. It's the type of sensation that you know you will never be the same: something has fundamentally shifted in you that will last probably the rest of your life. Which turned out to be true.

Tim Ferriss: Turned out to be true. What makes this lab unique or unusual?

Adam Gazzaley: Well, we are unusual in several respects. The first is that we do some very basic science in this lab. So we try to understand how

neural networks in the brain underlie higher order cognitive abilities: attention, memory, perception.

We try to understand how those abilities of our brain are vulnerable, for example, to distraction in multitasking. We look at how the brain changes as we get older in that regard. So I classify all that as sort of basic science. We're trying to understand how the brain works.

Tim Ferriss: You're using a lot of imaging.

Adam Gazzaley: And we use functional MRI, EEG, transcranial stimulation, tools of human neuroscience, human cognitive neuroscience. In that sense, we're similar to many cognitive neuroscience labs. But we do something different, and now it occupies more than half of our lab's efforts. And that's: we also have a research program to say, "How can we use our expertise or methodology, our perspectives, to not just understand the brain but to try to develop novel approaches to enhancing it, and then validating that our approaches are actually effective?" So, to be able to sweep across the breadth of discovery to invention to validation, and then even filing patents and then moving concepts out of the lab into industry, to really connect at that sort of scope – I don't really know any other labs that do that.

So I think that's a really unique aspect.

Tim Ferriss: I think it's very ballsy too, in so much as – and, again, this is just from someone who's spent a lot of time around scientists but who has never practiced as a real, serious academic in any way in the hard sciences – you're not only describing these basic scientific phenomena and answering these science questions, but you're also bleeding into the prescriptive, where you're looking at recipes and technologies that can be used to improve function, potentially even in so-called normal, healthy adults, right?

Adam Gazzaley: Mm-hmm.

Tim Ferriss: And that's, I think, one of the many reasons we get along so well. But what are some of the concepts or the insights that have made the jump out of this lab into the private sector?

Adam Gazzaley: Just to reflect on that a moment: when that happened, it was around 2008. So I'd been doing this for a long time already. I already had my own lab, had already made some really important discoveries on the brain and the aging brain and distraction and

multitasking. That's what I was largely known for, in my research. And then I basically became a little dissatisfied with just reporting the bad news: that our brains were fragile in ways that we didn't fully understand, that it all got worse as we got older. That's a great intellectually fascinating story for a bunch of scientists. For the general public, it's sort of a crappy story, you know?

Tim Ferriss: It's not the happy ending we're hoping for.

Adam Gazzaley: No. I joke around: the first time I gave a big talk to an audience of older adults about our discoveries on the aging brain and I closed the talk; I was staring at all these faces.

And they had a look on their face like, "Wow; I'm watching a movie, everyone died, and the credits rolled." They're like, "That sucks." And I was like, "You know, this is not how I want to end the movie." We could've gone on for another 40 years, as most labs do, and tried to understand all of the details and complexities of why these things happen, why our ability to focus and our attention declines with age. And we're going to continue to do a lot of that. But to be able to actually create things that can help these people – that's what is something I always wanted to do. And I wouldn't say I lost track of it. It just took a long time for us to get to the point that we could do it in a responsible way.

So, over the years, since we've had that transition – and it really started with NeuroRacer; now it's become much more extensive and expansive in our approach – the things that have left the lab are really largely built around our design principles –

on how we construct games from scratch, working with professionals. Because I give a lot of respect to video game professionals and artists and designers. But we work very closely with them and create the algorithms, and how multiple algorithms interact with each other to challenge the brain in an adaptive and high-feedback way that actually leads to change.

So that's what most of my patents surround: that concept that you can build that methodology to advance how our brain functions.

Tim Ferriss: This is where I massacre concepts that are sacred to a lot of people. Is it safe to think of the algorithm as, in this case, probably an adaptive algorithm which is a series of if-then statements that are formulated in a proprietary way and ordered in a proprietary sequence?

Adam Gazzaley: Yeah. That's appropriate. We tend to think of them, rather than if-then, as a full closed loop. That's how we sort of visualize what we're doing: we're creating a closed loop between an intervention – so you intervene in some way; you record the impact with as low latency as possible. So as short a time as possible, you see what happened –

[Crosstalk]

Tim Ferriss: As little delay as possible.

Adam Gazzaley: Little delay. With that information, we then cycle back, reformulate the intervention, apply again. And if you do that with as little delay as possible, you create this very powerful closed-loop feedback system.

Tim Ferriss: Got it.

Adam Gazzaley: And that is the most powerful way to change anything, whether it's a physical system with a diamond drill and you're trying to pummel into the earth, or you're trying to change a biological system like the brain. Our current approach to therapeutics and improving the brain, largely in the pharmaceutical world, using molecules, is a very open-loop system: very long time delays between the intervention, knowing what's happening.

Even the ability to know what happened is usually not quantitative at all. And then a very poor feedback system that leads to updating it. Right? Just imagine you go to the doctor; you have an attention problem or depression; you take a medicine; you go home; you subjectively record the effects and side effects; you go back a month later; you recount them. And then "We're going to go up on the dose a little bit." That is just not a way to change something, especially something as complex as the human brain.

Tim Ferriss: Yeah. It's playing darts with a blindfold on.

Adam Gazzaley: Yeah. And that's the basis of our entire mental healthcare system.

[Crosstalk]

Tim Ferriss: But you don't even need the dartboard for a month.

Adam Gazzaley: And some people respond well, and maybe they got lucky, and other people are just struggling. And this is a broad, big global problem. We don't have effective means of improving how the

brain functions across people that are suffering, that have disorders, and people that are healthy and just trying to improve their brains.

Tim Ferriss: When you think of the word "successful," who's the first person or who are the first people who come to mind?

Adam Gazzaley: That's a really good question. I think I've spent too much time thinking about people that are not successful to answer that question immediately.

Tim Ferriss: Why have you spent so much time thinking about people who are not successful?

Adam Gazzaley: Well, maybe not people that are not successful, but approaches that are not successful. Because I'm trying to find the holes in the system, the way of changing it in a meaningful way. And to do that, I'm looking for where we're missing the boat.

Tim Ferriss: And by "system," you mean just this kind of scientific establishment?

Adam Gazzaley: Yeah, changing the scientific establishment, but changing more of what we think about as medicine, especially when it comes to the brain. And I'd say education when it comes to the brain. So it's probably – maybe it's a fault; maybe not. But I really don't spend a lot of time looking at success cases.

I really spend most of my time looking at where we're not reaching the high bar that we should be, both in education and in medicine.

Tim Ferriss: How do you vet people who want to be in your lab?

Adam Gazzaley: Most people that want to be in my lab are pretty aggressive at trying to get into the lab. Usually that's a good sign.

Tim Ferriss: How many people, just for those listening?

Adam Gazzaley: We have a core group of full-time FTEs on the payroll of a little over 20. But our extended team of interns and volunteers is close to 100 people. So it's quite large. A lot of people come in the lab and spend time volunteering or interning just to get to know what we do and for us to get to know them. I'm looking for people who are very rigorous, very careful. I like people who are – how I describe it – sort of optimistically cautious.

They're conservative in that they're not over-inflated in what they say, but they're excited and they're enthusiastic and they think that there's something really here that drives them to be here.

Tim Ferriss: How do you establish that? So the rigorous side. Is it just all on their resume, their CV? Or are there behaviors you look for, questions you ask in interviews?

Adam Gazzaley: No. I don't really have a tight methodology on how I do that. A lot of it is that connection you get with someone when they're talking about what they do, what excites them. That's usually where I start: "What do you think about that really gets you excited?" Because I'm more interested in what drives someone and motivates them and makes them want to get out of bed in the morning than a list of classic resume check-boxes.

And once I hear that and look at them and hear them, obviously in the context that they have been successful in many ways, and have the type of requirements that we'd want in this lab – once we have that back-and-forth, then I know that that's the person who's perfect for this place.

Tim Ferriss: What are common misconceptions about the brain or cognitive function that just refuse to die? Like I'd love for you to comment on: "As we all know, we only use ten percent of our brains."

Adam Gazzaley: Yeah. I was going to say that one.

Tim Ferriss: Could you just dive into that for a second?

Adam Gazzaley: I have been unable to find where that originated from. The best I could find is that it seems that when the early researchers were exploring brain function in different areas, in animal models, they would make little ablations: they would destroy little areas of the brain and look at what was happening. And there are large areas of the brain that you can do that to that you wouldn't see an impact. You wouldn't see a negative impact.

You do that over the motor cortex, over the sensory cortex, over the visual cortex, bam: you can't see; you can't move; you can't feel. We know that this does that. But there are lots of areas of the brain whose function is a little bit more mysterious, and you have to see in a higher-order way than you can under anesthesia or even in animals. And so it started leading to the impression that there were some areas that just didn't seem to be doing anything.

We now appreciate that that's not true at all. The most complex structure in the entire universe doesn't have just a vacant parking lot waiting for someone to drive in and start building. It's all used all the time, and in complex ways that we didn't always understand. For a long time, we tended to think about brain areas as sort of like islands of blobs of function. We now know that real higher-order brain processing and function comes more from network interaction, how brain areas are communicating with each other.

And so one brain area might do something very different depending on the context of what other brain areas that it's communicating with are doing at the same time. So it's a very complex – what we call "multivariate" – system that's dynamic and constantly changing over time. And I think this complexity, that we've only really recently begun to understand to any degree, led to very sort of naïve views of the brain: that we didn't use it all.

Tim Ferriss: And the idea that there are very specific, discrete areas of the brain that are kind of like separate people on an assembly line who only do one thing is still very persistent.

Adam Gazzaley: Yeah. I'd say it's another sort of myth of the brain.

Tim Ferriss: What are some red flags that people can keep in mind to avoid the charlatans who claim to be scientists of the brain? Because there are a lot of people running around, kind of jumping up and waving their arms and so on.

Adam Gazzaley: Yeah. It's a frustrating thing for scientists and neuroscientists.

And to speak specifically about what I mean by that, the brain and science in general could be a very powerful marketing tool. It's had millennia of successes in technology, which is right in our face all the time, and really grew out of scientific exploration, and so we're constantly reminded at what a powerful tool science is. And the way you can think of challenging someone you think might not be using science in a legitimate way is that science is not really about what we have done; science is a methodology; science is an approach. And so basing something on science doesn't really make that much sense to me. I mean: almost everything is based in some way on science. If it's not based on science at all, we almost shouldn't even be talking about. Or it really falls into another realm.

Tim Ferriss: Because you're talking about rational inquiry and the sort of structured way of thinking about evidence or lack thereof.

Adam Gazzaley: Yeah. And we have this really massive framework that we've built to understand the world that gives us so much leeway into how we consider things; basing something on science is super low-bar. It doesn't mean that much. In the next hour, we could sit here with a glass of wine and put a thousand things based on science on the board.

Tim Ferriss: Right.

Adam Gazzaley: What's more important, and what's sort of being used in an imprecise way, is the concept of being validated by science. And what that means, and how hard that is to do, and the details and the complexity of getting there in a rigorous way that's peer-reviewed and defensible and reproducible – that's a different story. And so the basing on science is not so exciting to me. The being validated by scientific methodology: that's what we're all trying for. And I think that people should keep that in mind when they're reading something about science: is it really just being used as a marketing weapon or tool?

Or is there really a careful description of the research approach that went into it, and, of course, those limitations that exist that are inevitable? Everything has those.

Tim Ferriss: Yeah. And I think that's a huge one for me: if someone is painting their data or their approach to be the best, the perfect, and they're not very upfront about the limitations or the potential flaws in the data, that to me just reeks of pseudoscientists.

Adam Gazzaley: Yeah. It's impossible to do something that doesn't have a long list of limitations. I could easily go through them for my work, and I do all the time. Some of the complexities are driven by the media. I spend a lot of time with the media trying to hone my message and make a balanced message. And if you look, you'll see I have articles in *New York Times*, *New York Magazine*; I'm quoted.

And you'll see these little disclaimers and these balance points that I work very diligently with those journalists to say, "Hey, could you put this in for me as a sort of thank you for me taking the time to do this interview with you? Because, without this, it's just not fully balanced."

Tim Ferriss: Right.

Adam Gazzaley: But if you don't do that, very frequently you wind up with something that's really only capturing the highlights. And it's not that the highlights are wrong. They're just not the complete story.

Tim Ferriss: They're incomplete.

Adam Gazzaley: They're incomplete. For example, in our research, and even our *Nature* paper, we're massively excited by the elements we've found, but it is a step one. In my mind, it is a proof of concept. It's the reason we get excited that we have a signal there, that something's going on; that leads to larger studies to reproduce it and to show even more aspects of its sustainability. And also we never even looked at how those changes in the brain and cognition translate into people's lives. We would have needed much larger numbers.

And it's very hard to even tell that in any study because we don't have great quantitative markers of how someone's life is being impacted by something that we're doing. So those are just obvious limitations to me that I like to also express in addition to the things that we're excited about.

Tim Ferriss: What is the likelihood, do you think, that some video games that are already out there, preexisting video games, have some of the cognitive enhancement effects or maintenance effects that those devised in the lab do?

Adam Gazzaley: I think it's beyond likely. I think there's no doubt that that is true. As a matter of fact, we were inspired into the video game research in a pretty profound way by the work of colleagues of ours, Daphne Bavelier and Shawn Green, who showed, also in a *Nature* paper – there's only several *Nature* papers on video games, but another one in 2002 showing that –

consumer video games – first-person shooter games, the games that some people have the most trouble with because of the violent nature of them – that young people that played them would show much superior cognitive abilities compared to their peers that don't play these games. And if you take someone naïve that doesn't play video games and you have them play it, you also see these effects, especially compared to other games like Tetris.

And so I would say: undoubtedly, in my mind, there are active ingredients in consumer video games that could lead to brain changes in a meaningful and sustainable way, that they're there.

But because these games are built for entertainment purposes, I don't think they're going to go as far as they could if they were designed with an understanding of the brain and cognition in mind, and the population you're trying to impact.

Tim Ferriss: Right.

Adam Gazzaley: But, on the flip side of that, you also don't want to build something that's not fun and entertaining.

And that's what makes this field so challenging. To build from scratch and reach something that has the engagement, immersion, and enjoyment that a video game does – because people have a pretty high bar for what they expect out of a video game now, especially young people; they're like, "That's not fun. I'm not going to engage in that." So, to get there, and then to also have all of the mechanics and the video game engine itself target these brain processes – to do both of those: that's the ultimate challenge. And I think that's why we don't have a ton of examples of this being done at a really high level, because it is so challenging and requires –

Tim Ferriss: It's expensive too.

Adam Gazzaley: It's expensive and it requires people working together that traditionally have not. And so it requires an openness and a communication between professionals, both of whom feel – and are – expert. Video game professionals and artists and engineers and designers talking with scientists – both very strong-willed people, high-level performers.

Both feel that they know how to do their job. And you're like, "You're actually not doing your job; you're doing a new job that never existed. You're creating something together that's a hybrid." That's the challenge.

Tim Ferriss: The mention of first-person shooters reminds me: one of my more embarrassing outings in any activity ever was – I think it was my first game ever. I could get this wrong. I'm pretty sure it was Halo. It was my first game ever, and I sat down to play this guy who – I literally felt like I couldn't be on screen for more than a second without dying. Ended up being this guy named Fatality, with *I*s as the 1s, who I think is a world champion.

Adam Gazzaley: I think if his name is Fatality, you don't want to play video games against him.

Tim Ferriss: But the hand-eye coordination, and just his ability, almost presciently, to know exactly where I would be in this sort of three-dimensional artificial space, this virtual space, was mind-blowing. I could not believe how fast this guy was.

I'm going to switch gears for a second because I wanted to talk about some of the other aspects of your life as well. But what books – they don't have to be science-related – what book have you gifted most often to other people?

Adam Gazzaley: I'm a big fan of science fiction books. Most of my reading is on the future. I'm really mostly satisfied when reading books that are describing future possibilities and realities. I read a tremendous amount for my work, and so I read articles all the time. And when I'm not reading that, I find it most gratifying to just push my creativity, and not read about things that other scientists are doing, but read about potential futures. So, you know, starting with Asimov when I was a kid, the *Foundation* series: life-changing for me as a kid, and have still read it multiple times throughout my life.

So that's probably the biggest share that I've done: introducing people to Asimov and the *Foundation* series. But I'm reading right now books by an author, Peter Hamilton, and others. *The Reality Dysfunction* is a book that I tell people to read all the time.

Tim Ferriss: What was the title?

Adam Gazzaley: It's called *Reality Dysfunction*. It's a series called *The Night's Dawn Trilogy*. It takes place in the distant future. Great technology, great human interactions. It just stimulates my creativity to read really talented authors that are describing future possibilities.

Tim Ferriss: I want to drill into that because I love science fiction; love fantasy too. I'm kind of a fantasy nerd from way too much Dungeons & Dragons. I think also from too much Dungeons & Dragons, I tend to get obsessed with world-builders. So like Frank Herbert and *Dune*.

Adam Gazzaley: Yeah.

Tim Ferriss: Blew me away. *Stranger in a Strange Land*. *Highline* also. What aspect of reading science fiction – what aspect of the science fiction helps you to push your creativity?

Adam Gazzaley: I'm also a fan of world – or even beyond that: sort of the space opera genre where you just have so many characters and ideas interacting over thousands of pages. Those are my favorite things to read. And there's a lot of that out there. It's a definite category within science fiction and fantasy. No doubt, I'm inspired by futuristic technology. People that have some background that are smart enough to come up with things that are far beyond our capabilities but reasonable really excite me. So I would say that that's the part that drives my creativity: thinking about the technology and saying, "Wow, we don't have that. What would it take to have that?"

Sometimes you just can't get there, but it sits in my mind. Even now, in the lab, when I'm seeing all these things coming together, and sometimes I'm talking about it with someone; I'm like: it sort of sounds like I'm describing a science fiction book, but it's what I do every day. So I guess those worlds are starting to meet.

Tim Ferriss: So we watched a movie recently. I guess it's *Ex Machina*. That's how you, perhaps, say it. "Of the machine," or "From the machine" I guess, technically. It seemed immanently feasible in a lot of ways, which made it fun. You have a project that's going to be getting underway soon that I'd love to hear you talk more about. I'm not sure if this is the official name, but the nickname at least: Neuro Man?

Adam Gazzaley: It doesn't really have an official name. That's the name that we call it around the lab.

Tim Ferriss: It's covert. I like it.

Adam Gazzaley: The Neuro Man Project.

Tim Ferriss: So tell me about the Neuro Man Project. Because you work out every day?

Adam Gazzaley: Five days.

Tim Ferriss: Five days a week. Very fit guy. You've got the silver fox thing going, which I'm really envious of, because I do not have that. I have sort of the *True Detective* Woody Harrelson thing going. Moving into hopefully Jason Statham territory. But I digress. Where the hell was I going with that? Oh. You're very fit. You're very sharp cognitively. And yet – or I should say, most interestingly to me – this experiment or series of experiments that

you're going to be jumping into. So tell us, and tell me, more about this.

Adam Gazzaley: Okay. So this is a recent development in my life: this Neuro Man Project. It's sort of a fun title and a fun idea. As scientists, we have a very prescribed, regimented methodology that we go about doing an experiment.

You know, very carefully, placebo-controlled, blinded experiments, very rigorous analysis, very careful comparisons against other groups. And that's what we do and that's what we'll always do. That's how science works. That's how we're going to figure out if many of the approaches that we're taking in this lab actually work: the approach the validation. And while we're doing that, what I'm seeing happen is we're developing all these new games that are really exciting. Three of them we've been working on for two years now. And it's going to take us a long time to figure out if these work and to really understand the mechanisms and the individual differences: why some people respond, why some don't.

But what's going to take us even longer is to figure out how these games interact with each other. Because there's not a Holy Grail out there. There's not one thing that's going to fix us or elevate us to our satisfaction. What's most exciting to me is what we call a multimodal approach.

How do all of these games interact to elevate you? What are the other synergistic effects? How do they add on each other? Maybe pharmaceuticals can be dropped to a way lower dose and be added to enhance it; brain stimulation, neurofeedback. We do all of these things in the lab, and it's going to take us decades to look at how these all interact.

But given that we don't think certainly the video game play is likely to be very dangerous, I have decided to do a very unorthodox study on myself, more of a project, to – what I say to the lab is "Put my time where my mouth is," and say, "I'm going to treat myself like a research participant," even though it's not a formal study – there's no control group; more of a case study, which exists in our field, in many ways – and play three of our games: Meta Train, Body Brain Trainer, and Rhythmicity – I could tell you what those games are – play them all concurrently, which we don't do. We usually study one at a time. We've only studied one at a time. And these are in study right now.

Play them all at the same time over the same period of time for two months. And see what I can do to my own brain, my own cognition, other aspects of my physiology. So that's one goal: to see, if I look across – so we'll be doing everything in pre- and post-testing on me that we'd normally do in a study. So MRI, structural and functional, EEG during cognitive testing, stress measurements, blood work, inflammatory markers, epigenetics, sleep recording, all of that over a two-month period before and after, many things during, to see how engaging in these change these levels.

And we have dozens and dozens of 20-year-olds in the lab who come into the lab as participants, as data, to act as a sort of baseline. So my question is: how do I compare on these metrics to a 20-year-old? I'm 46 right now. And, with this type of training approach, what can I do to move these metrics closer?

How close can I get? Or can I exceed them? So that's one challenge.

Tim Ferriss: Return to the womb. Maybe you can get to like age three.

Adam Gazzaley: Well, that would a downswing.

Tim Ferriss: I'm totally kidding.

Adam Gazzaley: But seriously, it's actually a really good point. Because there is that turning point, that sort of peak where you develop, you develop, you develop, and then you don't really plateau for very long, we're seeing – we think. And a lot of data suggests that. And that peak is probably, for these types of abilities, maybe around 23 years old. So that would sort of be some of the highest levels we see.

So the project gives me the ability to just have fun and see what I can do with my own abilities, using approaches that I designed that our lab developed. But there are other benefits. It gives me a very humbling experience of being a participant in my own lab, and learning it from that perspective: where it's burden, where it's not. I get to see my games that I've designed from the inside out, like how they really function. I think that I can improve all these games by the experience, and even improve my skills as a game designer through this.

And so I think there are a lot of real benefits. It's definitely nothing that I've ever heard of a colleague doing. I mean, the reality is:

some people work on things that would just be plain inappropriate or dangerous experimental drugs, where we just don't know the side effects and it certainly would be unwise. But I think in this case, because of the type of interventions we're working on, I really have a little opening to do something pretty fun.

Tim Ferriss: I'm pretty excited about this. I wanted people to hear about it on the podcast because obviously we'll want to follow up. But the NF1 guinea pig, sort of Adam 2.0 project is, not surprisingly, very fascinating to me. Could you go through the three games and explain each of them?

Adam Gazzaley: Sure. So the three games: Meta Train, Rhythmicity, and Body Brain Trainer. Meta Train is an iPad-based game.

We've been working on all of these for years. This started as an NIH-funded study. And what the original design was: I took –

Tim Ferriss: National Institutes of Health.

Adam Gazzaley: National Institutes of Health. Correct. Where a lot of the more traditional scientific funding comes in. And it's been challenging to get video game therapeutic research funded, but it's slowly happening. And so what Meta Train is: I was inspired by mindfulness practice, and some of the data showing that these contemplative practices that have been around for thousands of years have impact on our minds and attention, beyond stress relief, but even cognitive impacts.

And so what I've done in Meta Train is take design principles form concentrative meditation and integrated them with our video game mechanics of adaptivity and feedback, and put it in an iPad. And then we've built this out several times with a big team here. Zynga philanthropically donated time and engineering support and money to help us actually build this out.

It's really fun to work with professionals that are trying to do some good in addition to their standard bottom line.

So that's what Meta Train is. So Meta Train teaches you how to better self-regulate internal distraction. At least that's what its goal is. And the hypothesis of Meta Train is that if you learn how to do that through the game algorithms, we'll see a benefit, that you can hold your attention to your breath for longer periods of time without being distracted. But the biggest win is that we'll see benefits on other aspects of cognitive control like working memory

and other externally-focused attention, and that we'll see changes in the brain and be able to understand the mechanisms of that. That's Meta Train.

Tim Ferriss: A couple of really quick, interruptive follow-ups on that. The first is: are you measuring things like cortisol, C-reactive protein and so on primarily as related to Meta Train?

Adam Gazzaley: We're doing that for all of our studies.

Tim Ferriss: Okay. Got it. But, in your particular case, do you hypothesize the highest correlation in those biomarkers will come from Meta Train?

Adam Gazzaley: Not necessarily.

Tim Ferriss: What an answer.

Adam Gazzaley: I think that all of them have the potential for stress management in addition to cognitive improvement, interestingly enough.

Tim Ferriss: Cool.

Adam Gazzaley: And so I don't know. And that's an example of why this is not a great controlled study: because I won't be able to see the differential contributions of the different games. But that's okay because we have many studies that are doing that. We have studies where all of these are done independently, and we'll see which has the most impact on that type of blood-based, sort of stress-related outcomes. So we'll see that. So that's Meta Train.

BBT – we call it BBT in the lab: Body Brain Trainer. We built that one entirely in-house with our own game design team and game development team. It is a motion capture game that's played using the Connect 2, part of the Microsoft Xbox One gaming platform, which is a pretty unique use of that platform.

And what BBT does is that it challenges you both cognitively and physically at the same time in one integrated game experience. So it's the first thing that we know that's really designed from scratch to do this with adaptive algorithms, both in the cognitive domain and physical domain.

So let me explain what I mean by that. All of our games are adaptive cognitively, meaning that as you improve, the game

detects that on a second-by-second basis, and then scales the challenge appropriately to your ability.

Tim Ferriss: It makes it harder: the better you get, the harder it gets.

Adam Gazzaley: It's like a personal trainer there every single second, picking up your abilities in a very quantitative way, and inching you forward. And if you're overwhelmed, then it will back off. But it will hold you at a high level of challenge, where it's not so hard that you're frustrated, not so easy where you're bored. That's a big part of our game engine. So cognitive-adaptive engines are part of BBT as they are Meta Train.

But BBT also has physical-adaptive engines. So, by that, what I mean is that before you play BBT, you get a VO2 max, which is a way of determining at what heart rate you should be challenged to be right at that sort of anaerobic zone where we're looking for these types of benefits.

What we then do is have our participants, including me, when I start playing this soon, wear a heart rate monitor. And we feed your heart rate into the game algorithm. So what happens is: if you're under our goal, the game will push you to have larger amplitude movements, faster movements. Once you hit your heart rate goal and exceed it, it could titrate it back. So just like we do on the cognitive side, from a physical/cardiac side, aerobic training side, we can also hold you right at that perfect level.

Tim Ferriss: And how are those instructions delivered? Is there a big mime on the screen that you have to mimic?

Adam Gazzaley: You're seeing your hands move, but that's really it.

You're basically just being challenged with cognitive demands across a 3D, beautiful game environment, pushing your working memory, your selective attention, your ability to switch between tasks. But you're not thinking about this from the cognitive or the physical perspective; you're just seeing these challenges in this sort of Mayan-inspired world that you're trying to return treasure to, and you're just grabbing for objects and making decisions and playing a game.

Tim Ferriss: Got it.

Adam Gazzaley: And that's the goal: to make it just a fun game that you work through over a two-month period of time. So Body Brain Training,

in its current formulation, is played three days a week for an hour each session for two months. So that's what I'll be doing. Meta Train is played for 30 minutes a day, 5 days a week.

Tim Ferriss: Got it.

Adam Gazzaley: At home. So Meta Train is a home game. BBT we play in the Neuroscape Lab, this new lab we have that we created just to be able to do experiments like this. We hope that this also goes home.

But the technology is so new. We actually, just today, interestingly enough, set up BBT at my loft. So I could potentially play. Actually I think my girlfriend, Jo, is going to be training on BBT at home.

Tim Ferriss: Very cool.

Adam Gazzaley: That's still an ongoing discussion, but she's into it; my lab's into it. So we might have Neuro Woman Project going alongside. Now she's like, "I want to do Meta Train as well." So we'll see what we do there.

Tim Ferriss: NF2: a love story.

Adam Gazzaley: I know. Exactly. The Neuro Couple.

So the last game that I'll be training on is called rhythmicity. Rhythmicity is a game that we've been working on with an indie game designer, Studio B. And the hypothesis here is that if we have a game that, through adaptivity, teaches you to become more rhythmic – which is also a question: can you become more rhythmic? We think you can. We're going to document that you can through game play. And then the question is: if you are now more rhythmic, is your brain more rhythmic?

Rhythm is a fundamental aspect of how our brain works. It's not just an artifact that we've discovered, that you have alpha, theta, gamma at different frequencies. But it's a core property of how our brain functions at the highest level; attention, perception, memory – all are driven by these rhythms. And not just the rhythms in isolation; coherence and synchrony, phase locking between rhythms. So because our brain, as all of our biology, and even all of our physics, is rhythmic in nature, does becoming more rhythmic improve the rhythms of the brain, improve your function, and other aspects of cognition? So that's the hypothesis.

The game is a fun game, similar in some ways maybe to a little bit of the interface in things like Rock Band and Guitar Hero. But instead of just playing different songs and having some level of complexity and adaptivity there, we have a very high level of high adaptivity. We're feeding you more complex rhythms at a faster tempo with less time across the audio and the visual domain.

So that's the last game, Rhythmicity.

Tim Ferriss: What is the protocol? The frequency and duration of sessions?

Adam Gazzaley: Rhythmicity's probably going to have a similar protocol to Meta Train, although we're still formulating that. That's the least developed. So both Meta Train and BBT are already in study. Rhythmicity is just finishing game development but will be ready for me in July for my training. It will probably be 5 days a week, 30 minutes a day.

Tim Ferriss: You've spent a good amount of time – just coming back to the rhythm – with world-class drummers, have you not?

Adam Gazzaley: Yeah. That's actually how Rhythmicity was inspired: through my relationship and friendship with Mickey Hart, who's the percussionist from the Grateful Dead. We were doing a talk together in New Orleans for the AARP because he had a really profound experience in his life because his grandmother, who had Alzheimer's disease – and he was a caregiver for her – she didn't speak to him for a long time.

And then he was playing the drums with her one day and all of a sudden she just got into the groove and said his name, and he was just blown away. And all of a sudden music and rhythm, from being a tool of entertainment, became something more. And he's been different ever since. I mean, he's always been on this kick; he's spoken in front of Congress many times. We've spoken together at the White House and Congress, South by Southwest, all over the place, about rhythm and the brain.

So I was really inspired by his own impressions and his own passion for rhythm as a therapeutic tool, and his own frustrations that no one has really done the study that I described to you. We know that people who have high levels of music training experience in their lives: when you look at their brains when they're older, they're not like other older adults; there are definitely some improvements and some advantages. But there

isn't really a carefully controlled study of what elements of music – I mean, there are many things that go into being a musician.

Tim Ferriss: Sure.

Adam Gazzaley: So it's provocative, but –

Tim Ferriss: Not to mention just the kinesthetic element.

Adam Gazzaley: Oh, exactly. And so many things. And so it's interesting; it's a signal something might be there. The same thing with meditation training: very hard, in a very carefully controlled study, to pull out: "What are the active ingredients?" And "Is this element of either meditation or physical fitness or rhythm" – so that's a commonality: these practices often sit in what we think of as "alternative." And I don't think that that is doing them justice, right? Because they're not being prescribed; they're not really part of what we think of as medicine. And hopefully, through these types of studies that we're doing now – where we take active ingredients of them, drop them in our game engine, and then do placebo-controlled studies – we'll start validating this at the level that professionals are like, "I would prescribe that."

Tim Ferriss: Yeah. Absolutely. And that opens up a whole Pandora's box obviously of insurance reimbursement and so on, so that it becomes more economically feasible, and even attractive potentially.

Adam Gazzaley: For sure. And that's what we hope to see in the future.

Tim Ferriss: With drumming and music, just two quick side notes. One is: there's a great short movie called *The Lady in Number 6*, which is about 30 minutes long. It's about the world's oldest living pianist and Holocaust survivor, 109 years old, named Alice. She still plays the piano every day. It's a fascinating watch. The other, which is even shorter, is a YouTube video. I think it's three to five minutes long. It really blew me away. Because I have Alzheimer's and Parkinson's on both sides of my family. So this is, as you know from our conversations, an area of great interest to me, and why I was, for a very short stint, sort of a dilatant neuroscience guy –

Adam Gazzaley: Yes, you were.

Tim Ferriss: – at Princeton for a year or so. And why I've enjoyed spending so much time in this lab, among other reasons. But it's a video.

And I think if people just search "Alzheimer's patient listening to music from his era" – they took this gentleman – he must have been in his 80s, maybe even 90s, African American gent, pretty much mute, vegetative practically.

Adam Gazzaley: I've seen this video.

Tim Ferriss: Oh my God. And then they take music that he would have heard when he was young and play it to him, and he starts having a normal – having an entire conversation.

Adam Gazzaley: Yeah. It's profound.

Tim Ferriss: It's really profound.

Adam Gazzaley: When Mickey and I first started interacting, I was looking for other examples of that and sharing them with him. There's so much we do not understand about the brain and its wonders, and how to control it, and how to allow our ability to impact it improve our lives. And those types of things are inspiring. And if we could distill them down and make them systematic and reproducible so it's not just some very amazing but rare event, but something that's reproducible and prescribe-able and deliverable, that would be just game-changing.

Tim Ferriss: Yeah. So it's not something you hope for, but something you can engineer.

Adam Gazzaley: Right.

Tim Ferriss: What is the fascination with photography? And obviously those of you listening can't see this: you've got two gorgeous large dual screens cycling through photographs. I know you are an avid photographer. When did that start? And why did it start?

Adam Gazzaley: Yeah. These are some of my photographs from over the years. I have a couple hanging up here as well. I never did anything artistic in my entire life until I was in my late 20s. And I was at my family's house, and my uncle, who had recently married into my family, is a radiologist and also a very avid photographer, amateur photographer, but even more than that, he was very into collecting cameras and photography equipment. And he gave me a book by a photographer by the name of Galen Rowell, actually a Bay Area photographer.

Tim Ferriss: How do you spell "Rowell"?

Adam Gazzaley: R-O-W-E-L-L. Rowell. Galen: G-A-L-E-N. And he is one of the world's most amazing photographers. He unfortunately passed away right at the time that I moved here. And I had met him once at a lecture of his, and he was looking forward to discovering the brain. Because he had a great interest in cognition. And he wrote this book called *Mountain Light* that my uncle shared with me. And *Mountain Light* is an amazing book because one page is a beautiful nature photograph, and the other page is complete text. And in there, it describes the nature experience, which was amazing to me, being a New Yorker, not exposed to nature all that much, the technical elements of photography, which appealed to my geek personality – all the little details to get it perfect – and then really a little bit of a view of cognition, which is my field – talking about perception and attention.

And this was something that Galen really appreciated. And page after page of beautiful photos, and then all those descriptions, just captivated me, made probably what I'd call another life epiphany. And my uncle saw that – I read the book for eight hours – went up to his room and brought down a camera from the year I was born, a Nikon from 1968, and said, "Here you go. This is a gift. This is yours. This is your camera." It was totally manual, almost impossible to use. He gave me like 32 rolls of film, a case of unopened film, and then basically took me up to their balcony – this is in Long Island – overlooking a wooded scene, and taught me how to use the light meter.

I went back. I was living in Manhattan at the time, going to medical school on the Upper East Side at Mount Sinai. On my balconing overlooking Manhattan – I got really lucky: I had support; I didn't even own a tripod then – I took a couple photos of this amazing sunset in August that, after I had developed, I was like: they were just amazing.

And I showed them to people and they were like, "You're a really good photographer." "I am?" Which wasn't true, of course, at all. I just got really lucky. But that early positive feedback made me think that maybe I could do it. And so I spent months being not a good photographer in Central Park, learning how to do nature photography. And it captivated me. And I went and spent many years traveling around the world, doing photography. I started a company called Wanderings. I built my website, Come Wander, in 1999 using html, not even any program, and sold a lot of photos. I did my own printing. Most of my sales were to hospitals,

interestingly enough. I had a nice connection there since at this point I was a neurology resident.

Tim Ferriss: Right.

Adam Gazzaley: And I had a captive audience, late at night, of all the nurses and other support team who were just sitting around with me at 3:00 in the morning in an ICU. I'd say, "Here's some of my nature photography."

And so I do my own printing. And we realized that hospital rooms, waiting rooms, ORs, ICUs could use a little bit of nature. They're just pretty sterile places. And so we started realizing that it was having a sort of profound impact on patients. And so I had a nature photography career for a while.

People have often asked over the years: is there a relationship between me being a scientist and a photographer? Especially when I was active in both of those things. And one part that was quite obvious to me was that, to me, they're both an exploration of nature. That's what science is: you're looking for organization and meaning. And that's I would do in nature photography: look for organization. And granted, in the photography, I was more looking for aesthetic, and meaning from an emotional response. And in the lab you're looking more for organization at a different level.

But they really weren't all that different.

Tim Ferriss: No, not at all. I think often of this video – there's also an essay, and at it's probably, at this point, a book – which comprises an interview with Richard Feynman, who won a Nobel Prize.

Adam Gazzaley: Yeah. When you were asking me about people that are successful, he was actually one of the first people that jumped into my mind.

Tim Ferriss: He is a great one: bongo player, safe cracker.

Adam Gazzaley: I would put him at the top of the list.

Tim Ferriss: A real character. So the video, which people should be able to find – if you search my name and the video, I've kind of tracked down a higher-quality version – is *The Joy of Finding Things Out.* And he would have these debates with some of his artist friends, and they would say, "Well, you think on the molecular level, and the beautify of the flower is lost on you." And he'd say, "No, actually I totally disagree. If I understand the inner workings of the flower, I

think it gives an extra layer of depth so that I have more appreciation of the flower."

And started learning to paint when he was well past his prime in terms of his career in his work with – after the Challenger disaster and so on and so forth. But a fascinating character. That's one of my favorite books: *Surely You Must Be Joking, Mr. Feynman!*

Adam Gazzaley: Yes. I read that many years ago.

Tim Ferriss: What a hilarious, incredible guy.

You operate at a very high level in the lab, managing a lot of people, juggling lot of different projects. What are your morning rituals or routines? What does the first 60 to 120 minutes of your day look like?

Adam Gazzaley: A little coffee involved, a little breakfast.

Tim Ferriss: When do you wake up?

Adam Gazzaley: I wake up like 6:00 or –

Tim Ferriss: I'm going to bug you with the details.

Adam Gazzaley: I wake up at like 6:00 to 6:30 a.m. No matter what time I go to sleep, I try to get up. I usually don't set an alarm. I'm very responsive to light. I have a big loft with open windows and skylights, and I don't close them in any way.

And so I like to wake up with the light. You know, easier in the summer. I get up, shower, coffee, small breakfast usually, like an egg or some protein.

Tim Ferriss: How do you take your coffee?

Adam Gazzaley: Just a shot of espresso. So pretty straight up.

Tim Ferriss: How do you make your espresso?

Adam Gazzaley: I usually use an espresso: so just get it nice and fast. On a weekend, I'll go out and get a nice –

Tim Ferriss: Schmancy San Francisco coffee?

Adam Gazzaley: A higher-quality cup of coffee. But for the most part I'm just really about just getting things done in the morning so I can get out of the house and usually go to the gym. So lately I go to the gym, train in the morning before I start my work day.

Tim Ferriss: What time do you get to the gym? You wake up at 6:00, 6:30.

Adam Gazzaley: Yeah. I'm at the gym by 7:30, 8:00. 8:00. I'm actually just reworking my schedule now, which is why I hesitated for a moment.

Because I'm going to be moving to 7:30 where I'll be doing BBT training as my physical workout in the morning three days a week, starting in July, July 6th. Traditionally, I've moved between afternoon and morning workouts. But I've really been enjoying the morning workouts for a bit now. I feel really energized by it. So I'm in the lab – even the fact that I woke up, had breakfast, worked out in the gym – 30 minutes of cardio, 30 minutes of weight training is usually my routine; been doing it since I've been 17 years old in one form another. And then I'm in the lab at 9:30, 10:00 at the latest. And most people are just rolling in to start their day at that time.

Tim Ferriss: I hate that feeling. I'm that guy who comes in and is just like, "I hate you, Adam. You've already done more than I'll get done in the next six hours."

The working out: do you record your workouts in any way?

Adam Gazzaley: No.

Tim Ferriss: It's more of a kind of instinctive: "How I'm feeling today"?

[Crosstalk]

Adam Gazzaley: Yeah. I have a regimen. I work out two body parts a day, three days a week, and then on the other two days I sort of just have fun, do whatever I'm in the mood for. So that's my weight training workout. And then the cardio workout is bike, treadmill, or elliptical for 30 minutes.

Tim Ferriss: And you and I were chatting before we got started with the record button pressed about exercise. And I enjoyed getting into it, and I want to explore it a little bit, because it seemed like we exercise perhaps for very different psychological needs. So I was mentioning that I almost always train by myself and have

historically, because it's been my meditative time, my time to, say, count, which is how a lot of people meditate. It just happens that I do it while moving, in this particular case.

And so I would almost always have earphones in, oftentimes even without music, just so people wouldn't talk to me. And I train by myself. But you seem to get something else out of it. So I was hoping you could just elaborate.

Adam Gazzaley: Yeah. I've always, for the most part, had a single workout partner, over the last 20 years of gym time. And it's someone who's also very compatible from a physical fitness point of view of what they're trying to achieve. It was my friend Brian back when I was in New York City, my friend Darya over the last eight years here in San Francisco. And there's an intensity there: you're definitely pushing each other to work out, both to get to the gym, to not miss, and also to get through a high-level workout and not cheat. But then there's also a little human connection, a little talking without an agenda, just "What's going on in your day? What are you thinking about? Did you have any crazy visions you want to talk about?"

Some small talk. And I don't really have a lot of that in my life. Everything's pretty intense and pretty goal-directed. And so it's, I think, a type of relaxation, and maybe a little bit of humanity that's served a valuable role to me.

Tim Ferriss: A little bit of therapeutic release, it seems. And what struck me when we were talking about this is that I don't have a lot of that in my day either. Because I'm typically working by myself. Every once in a while I'll work in one of the offices, one of the startups that I advise or have invested in. But I also need that type of therapeutic, no-agenda time. But the way that surfaces then – the way that I satisfy that – is by going out and having drinks. And I think that is probably one of the reasons. It's not because – I do enjoy wine, but I don't feel compelled. I don't have a wine deficiency. I don't need to drink it five nights a week. But I'll go out and I'll be like, "Okay, I don't want it to be 15 minutes long, so I'm going to have more than one drink."

And so we end up kind of waxing philosophic for an hour. And so it just struck me that maybe I should start working out with someone. Because it would satisfy that need, scratch that itch, and I would be less inclined to have three glasses of wine four nights a week.

Adam Gazzaley: Yeah. I think it's a great place to do that. You also get the added benefit of having someone push you from a physical fitness point of view. But I agree: I think it's incredibly valuable. Everyone needs that little open time to let their minds wander and to laugh and to say things that you're not so worried about because you're not in front of an audience like I am frequently. So I do think it's valuable. And if you're looking for a workout partner, I actually have a slot opening up.

Tim Ferriss: That's true. We should actually. You know what? Lightning strikes.

And you mentioned Darya. Many of you know one of my close friends is Kevin Rose.

He is married to Darya. And I saw something funny recently which was: somebody on Twitter said, "@KevinRose just announced that he's moving to New York City. In related news, @TFerriss just changed his relationship status to 'It's complicated.'"

Adam Gazzaley: That's awesome.

Tim Ferriss: Yeah. I'm going to miss those guys.

Adam Gazzaley: Me too.

Tim Ferriss: I'd imagine you spend a fair amount of time in New York.

Adam Gazzaley: Yeah. New York is my home, my original home. San Francisco's most definitely my home now, and I love it here, and I have no intentions of leaving. Although we have so many good friends in New York now, and I'm very good friends with Kevin and Darya as well. But my family lives in Chelsea: my parents, my sister. And my other sister lives in Upstate New York. And so I go back to New York all the time. And that's where I spent my whole childhood and early adult life. And going to New York, to me – I always say it's like jamming energy right into your brain. It's like: charge you up. And no places I've ever been has that amount of just pure human energy.

Tim Ferriss: Potential energy.

Adam Gazzaley: Yeah. It feels great. And so even a long weekend in New York – I'm like, "Okay, ready to go back to San Francisco."

Tim Ferriss: I feel like it's kind of like holding onto the third rail in a way. It's so stimulating that I find it excessive for my system past a certain point.

Adam Gazzaley: Yeah. And, in reality, having been someone who's lived there for a long time, it's different when you live there. You learn the guy who sells you coffee on the corner on your way to go to work. And all of a sudden your blood feels really familiar and then your neighborhood. So it's not always like that when you're actually a resident.

Tim Ferriss: Yeah. I supposed that's – yeah.

Adam Gazzaley: It's not as much as you might expect. Once you live there, you do get into that routine, and it does feel smaller. But it's a unique place in how energetic it is, and how energetic the people are. And so I do agree: it's a lot.

Tim Ferriss: It has a lot of horsepower per square foot.

Adam Gazzaley: For sure.

Tim Ferriss: It's a very dense energetic environment.

Let me ask a couple of rapid-fire questions. I always say that, and then I'm very long-winded, so I'll try to keep them short. But the answers don't need to be short. They can be, though. When you are feeling down or self-doubt, fill-in-the-blank negative emotion, what do you look to for inspiration or to get you back on track? Or what do you do?

Adam Gazzaley: Well, in all reality, I'm pretty even-keeled in terms of my mood and in terms of my outlook.

Tim Ferriss: Have you always been that way?

Adam Gazzaley: As far as I can remember. I don't really fluctuate all that much. I mean, I get stressed. And of course if something crappy happens, then I'm bummed out. But I don't really get too derailed or get caught in a rut. I don't really have that many memories of that. Usually if I am derailed in any way, my favorite thing is just interacting with my friends.

You know, going out and having a nice dinner, getting a drink, and watching some music. Live music is a frequent source of release for me.

Tim Ferriss: Live music.

Adam Gazzaley: Live music.

Tim Ferriss: Any type?

Adam Gazzaley: Lots of different music. I like what most people would call alternative, which has changed dramatically from new wave to whatever it is now. But yeah: watching musicians perform who are talented and passionate, and feeling the vibe of the music, and dancing, or just being at a festival: I love that. So I'm a very social person for someone who's spend as much time in academics and a lab as I have. I throw a party every month. I feed off of that human energy. So I would say if I am feeling not at my normal level mentally or emotionally, my social interactions are usually the way that I find to get back.

Tim Ferriss: Well, you're very, I would say, extroverted also. So it's kind of medicine for the extrovert.

Adam Gazzaley: Yeah. I would say that's true.

Tim Ferriss: Do you listen to music when you work?

Adam Gazzaley: Often.

Tim Ferriss: What type of music? What is your most-played band or track or station at the moment?

Adam Gazzaley: Well, I have a very unusual way, I think, of listening to music. I almost always listen to music I've never heard before. I have my favorites in the gym. I of course have a playlist. When I really want a quick fix, I have my favorite of whatever that time is.

Tim Ferriss: What are those?

Adam Gazzaley: Well, it changes all the time. Most of the bands that I listen to I might have just discovered a couple months ago. So, for example, recently I've been using the Discover feature on Spotify. And you have these *recommended*s. And I'll just let it go for a bit. And if, sort of in a bottom-up way, something triggers and I hear it, I'll be like, "Oh, let me listen to that.

"Oh, Tame Impala. They're interesting. I sort of like their vibe." So I'll listen to them for a while. Bands that have captivated me for

a long time like Radiohead. I like bands that are explorative musical styles; you know, Dave Matthews Band. But, for the most part, I really try to listen to as much new music as possible.

Tim Ferriss: Cool. And you use Spotify on the desktop as well?

Adam Gazzaley: Spotify on the desktop, yeah. For the most part. So when I'm sitting here – it's probably open right now on some screen here. So I was just flipping through. I look at what other people whose music taste I like – what they're listening to. And I keep a pretty active playlist for my party. And I like it to be fresh. So I'm constantly looking for music that can attract my attention away from what I'm doing. I'm like, "Ooh, I like that."

And then once I hear that, I'll go and pull that band out and see what other stuff they've created and then listen to them a while.

Tim Ferriss: You walk into a bar; what drink do you order?

Adam Gazzaley: It really depends. I would say my go-to is a really nice whisky, maybe with just a cube in it; if I'm feeling a little fancy, maybe an Old Fashioned. There are some times I just want a glass of wine or a beer. So it really depends.

Tim Ferriss: You're such a scientist. You have "It really depends" for everything.

Adam Gazzaley: It really does.

Tim Ferriss: The whisky: any particular whisky?

Adam Gazzaley: I'm a rye whisky fan. Rye first, then bourbon, then Japanese whisky, and then scotch, I would say, in that order. And rye whiskeys – I like so many of them. And I'm always changing what's my favorite.

Tim Ferriss: Recommend one and I'll try it tonight.

Adam Gazzaley: WhistlePig?

Tim Ferriss: WhistlePig.

Adam Gazzaley: Yeah. That's a good one, sure.

Tim Ferriss: I'll try it just for the name.

Adam Gazzaley: Yeah. It's a great name. I think I have some in my lab.

Tim Ferriss: I think that's my nickname.

Adam Gazzaley: Some in my office here. I could put some of that out. Yeah, I know. Ryes are an interesting whiskey because they really were the dominant form of American whiskey pre-prohibition because the industry was more north; you know, Pennsylvania, Vermont, New York, where rye did really well. And then, with prohibition and the move south with corn, bourbon really exposed, which is still, by far, dominant. But ryes coming back, and I love it. It's really earthy and just delicious.

Tim Ferriss: I agree 100 percent. What biography is your favorite, if any? Do you read biographies?

Adam Gazzaley: I don't read all that many. I've read some. I most recently read the Steve Jobs biography, the Isaacson one, which was pretty fascinating.

Anyone who lives around this neighborhood: you sort of have to read it or they could ask you to leave San Francisco. So that's a requirement. Yeah, but when I was a kid: Ben Franklin, Teddy Roosevelt. I was really influenced by a bio – I don't even remember who wrote it – of Teddy Roosevelt, which was really pretty cool.

Tim Ferriss: Why were you so – how did it influence you?

Adam Gazzaley: I like hero stories. I've always been attracted to people who have sort of challenged their status quo and were successful at it, and sort of marched to their own beat.

Tim Ferriss: I have a recommendation for you. Since you gave me WhistlePig.

Adam Gazzaley: Yeah.

Tim Ferriss: There's a book called *Tuxedo Park* about Alfred Lee Loomis, who was a masterful stock market investor, got out before I think the 1929 crash; was one of the few who not only survived but really exited at the top. He was an amateur scientist, but one of those kind of old-timey really impressive amateur scientists.

In the sense that Ben Franklin was kind of like an amateur scientist, but you're like, "Wait a second." And he financed this place similar to Bletchley Park, in a way, which, for anyone who's

seen *The Imitation Game*, will sound familiar, because that's where, of course, they were cracking Enigma. But he brought in scientists who would otherwise have no contact with one another to develop technologies, some for commercial use, but many of them for wartime use. Fascinating story.

Adam Gazzaley: Wow. It sounds great.

Tim Ferriss: And like almost all of these heroes too, a very flawed character.

Adam Gazzaley: I'll put it on my list.

Tim Ferriss: Yeah. It's a great book.

If you had to choose between losing your hearing, your smell and taste, or one eye, which would you choose and why?

Adam Gazzaley: Oh, man, that's bumming me out even thinking about any of those things.

Tim Ferriss: I couldn't make it both eyes because that I think is too much of [inaudible] –

[Crosstalk]

Adam Gazzaley: No. Everyone would keep their eyesight.

Tim Ferriss: Yeah.

Adam Gazzaley: You'd be too incapacitated by it. I would say one eye. I love food. Without even just smell alone, I'd lose so much of those things that give me pleasure multiple times a day. And, like you just heard, I listen to music all day long. It would suck losing an eye, but at least I could see and hear and smell. So I'll go with that.

Tim Ferriss: Go with one eye? And you'd get a cool eye patch out of it as well probably.

Adam Gazzaley: Yeah. Exactly.

Tim Ferriss: What are your hopes for – let me rephrase that, actually. That's too speculative. What do you hope to do with virtual reality in the near future?

Adam Gazzaley: We don't fully understand the potential of virtual reality in any domain because it doesn't really exist. So even from an entertainment point of view, it's fascinating.

But the ability to create such a real and immersive experience, both visual and sound – that's the real goal; and obviously haptic too, if we could have tactile feedback. But even just visual and sound; I mean, I don't think of it as a visual modality at all. To create that real experience, in a setting that would otherwise not be accessible to that type of experience, gives us the potential to heighten the human experience in many ways. You could heighten it from a pure enjoyment perspective, which is where most of the technology is driving right now. But to use it as a way to elevate our minds is really exciting to me.

And so we in this lab have been putting a lot of thought into: what type of interactivity in a virtual reality environment would lend itself to enhance our brains work and improve our existence?

And we don't know all those answers, but we're experimenting with them.

Tim Ferriss: And there are some really interesting things that it would seem you could do potentially in this lab also. If you had an Oculus and then, for instance – what are – you've, I'm sure, seen this: it's effectively an unpowered treadmill with a waist harness.

Adam Gazzaley: Omni.

Tim Ferriss: Omni. It allows you to run in any direction.

Adam Gazzaley: Yeah. Virtuix's product, Omni, which – we're slated on the top of the list. I just had a conversation with their president and CEO about: that will be delivered to my lab as soon as it's finally out the door. We're actually a Kickstarter investor in that. We're serious about our technology. We've invested in many Kickstarter projects, many of which we haven't seen yet.

[Crosstalk]

Tim Ferriss: Really [inaudible].

Adam Gazzaley: But we're hopeful.

Tim Ferriss: But you've had 700 update emails, I'm sure.

Adam Gazzaley: Yes. A lot of emails. But yeah. So the Omni gives us the potential that we can actually move and walk in virtual reality. So that's incredibly exciting.

Because the more I play BBT and think about embodied cognition, not being a floating jar with some fingers and eyeballs, but actually being a moving human being, I see the value in that. And so I love the idea of most of our games having an embodied format. And so virtual reality where you could walk and move is pretty exciting.

Tim Ferriss: Yeah. This makes me think of the simulacrum. If we have the potential to create movies that have animals that are so photorealistic that they're indistinguishable, to most people, from actual nature footage, and if we're at a point in the very nascent game of virtual reality where we have something like the Omni and so on, it seems epistemologically arrogant to think that we are the only people at any time in any dimension who have achieved that ability.

And it brings up a lot of interesting sort of philosophical questions that would have only previously existed in a freshman undergrad philosophy class.

Adam Gazzaley: Oh, for sure. I'm even more excited about not using virtual reality as a way of expanding outward, but expanding inward. So we have a project here where we created something called the glass brain. If you look that up online, you'll see plenty about it, and see some videos on it. But essentially it's a high resolution view of our brain, both structurally, using and MRI scanner in our center here, as well as EEG, to capture online electrical activity in your brain.

Tim Ferriss: Wow. This is the animation that you showed me of Mickey Hart.

Adam Gazzaley: Yeah. Exactly.

Tim Ferriss: That's amazing. You guys have to Google this. It's really cool.

Adam Gazzaley: We first did it for a gig that Mickey and I were doing; in many places wound up doing this, as I mentioned before: in front of Congress, at South by Southwest, in other places.

But now we keep advancing the technology, and we have a virtual reality version of it. So you could put on, let's say, an Oculus Rift, grab an Xbox joystick, and if we've already scanned your brain and we've done all of our processing and you're wearing an EEG

cap, fly inside your own functioning brain, which is an amazing experience.

Tim Ferriss: Wow.

Adam Gazzaley: And where do we go with that? Well, one really sort of amazing potential is that you can essentially play a video game using the signals in your own brain as the stimuli of the game.

Tim Ferriss: Wow. That could get super recursive really fast.

[Crosstalk]

Adam Gazzaley: So we're exploring that. So basically a very sort of futuristic view of neurofeedback where you learn how to control your brain rhythms by interacting with them sort of in situ, in the place in your brain where they're coming from. And this is what I was saying earlier, when what I do on a day-to-day basis starts sounding a little like my science fiction books. But we're there. We're doing this already.

There's an imagine here – these two guys.

Tim Ferriss: So the image we're looking at is two people sitting down. It looks like they have VR headsets on.

Adam Gazzaley: Both of them have VR headsets. The person on the left is Mickey Hart, Grateful Dead percussionist. He's wearing a VR headset and a 64-channel wireless EEG cap. So he's in VR and he's playing a rhythm game, an early version of Rhythmicity.

Tim Ferriss: And just for people living, 64 channel basically means 64 –

Adam Gazzaley: Electrodes. So it's a high-density cap, but it's mobile; it was custom-built for this lab, and pretty exciting technology on its own. So he's in VR, playing this game. He's looking at this beautiful space scenario with all Grateful Dead little shout-outs everywhere. And he's having fun. And that's showing up on one screen. This is a 120-foot-wide screen, 24 feet high. A keynote that I gave at the NVIDIA GTC conference in San Jose. So 3,000 people in the audience, giant screen. This is the demo after my talk.

So Mickey's in there doing that. The guy next to him – his name is Tim Mullen. He's one of our head engineers; really brilliant guy from UCSD. He's wearing virtual reality googles, and Oculus Rift, but he's actually flying inside Mickey's functioning brain while

Mickey's in his own virtual reality. So I always think of it and say it's like Russian neuro-nested dolls, you know? Mickey's in his virtual world playing his rhythm game, wearing his EG cap, and Tim is just looking around his functioning brain while he's doing that.

Tim Ferriss: So trippy.

Adam Gazzaley: Yeah.

Tim Ferriss: I mean, how much of our current reality, at some point, are we going to realize is just like that set of nested Russian dolls?

Adam Gazzaley: Yeah. We did this live in front of an audience last year. This is all possible.

Tim Ferriss: I want to kind of sniff test a theory that has floated around for a few decades. And you may have come across this before. But I'd be curious to get your thoughts. Because I just saw an article today. This was actually not an article.

It was a link to a study abstract which was I want to say on PubMed, and it was looking at the historical use of hallucinogens by indigenous people, primarily in South America, to improve the hunting ability of their dogs. Really fascinating stuff. And we could go down that rabbit hole, but just to try to – talk about multitasking – keep myself focused for a second, there's a theory of hallucinogenic experience – there are many theories, obviously, many of them completely speculation. But one of them is that the hallucinations are not all internally generated. And, instead, that the hallucinogens are basically deactivating filters that would otherwise block out this noise that we see or hear as hallucinations.

Is that conceivable, based on our current understanding?

Adam Gazzaley: We get a lot of signals into our brains through all the receptors we have. Obviously there are many signals out there that we don't have receptors for. So I wouldn't think that a hallucinogen would allow you to receive signals that you don't have receptors for. That would be a little bit of a stretch, from my perspective. But I never say never. I just don't have any hypothesis of how that would happen. But it is possible that you could be interpreting things that may have not been in your awareness, or even been inhibited by your top-down conscious control that is now released, not even just in hallucination, but in dreams as well. So yeah: I think that it's

sort of coming internally, but your internal world has been painted and sculpted by your external experience.

So I bet it's some combination.

Tim Ferriss: We talked earlier about the multimodal approach. And let's just say you have Meta Train, you have BBT, and then you have Rhythmicity. And you mentioned you could potentially at some point add in a pharmacological intervention and potentially that the multimodal approach would allow you to get a kind of higher yield from a lower dose.

Adam Gazzaley: Mm-hmm.

Tim Ferriss: When you get to that point or if you ever got to that point here, what are the compounds that would be kind of on the short list for exploring?

Adam Gazzaley: Well, there is a whole class of drugs that fell into the cognitive enhancement domain that really became Alzheimer's drugs called cholinesterase inhibitors, boosting the acetylcholine system.

And these cholinergic agents act pretty bluntly to, in many ways, improve attention. But there's a limit, and side effects associated with higher doses. So I think it would be pretty interesting to see what they might look like at a lower dose, but when you're activating the attention networks appropriately. I think that that is a really important question: how do they interact? We don't know that yet.

Modafinil is a drug that has had some cognitive enhancement data that seems interesting enough to look at an interaction as well. So I'd say those two.

Tim Ferriss: On the cholinesterase inhibitor side, are you looking at something that is potentially prescription medication? Or would it be like a Huperzine-A type of over-the-counter thing?

Adam Gazzaley: There are plenty of prescription medicines out there that I've –

Tim Ferriss: Is Aricept –?

Adam Gazzaley: Yeah.

Tim Ferriss: That's a cholinesterase inhibitor.

Adam Gazzaley: Yeah. Exactly. That's the most prescribed one.

It's the drug I'm most familiar with because that's what I prescribed the most when I was seeing patients. So, as a neurologist, I saw patients for many years. And most of them had early Alzheimer's disease, cognitive impairment associated with aging. And Aricept was really our first-line agent. It still largely is. And, to me, it's so crazy: we really give people these drugs when they have cognitive impairment, and most of the time we don't tell them to do anything, right? So, to me, it's always like a bodybuilder taking steroids and not working out anymore, or getting high-performance oil for your sports car and then leaving it in the garage. You've got to run it through the engine to get the benefits.

Tim Ferriss: Yeah.

Adam Gazzaley: So I feel like we've really missed the boat on understanding how, as I mentioned, a really blunt instrument like these neurotransmitter receptor modulators – how they interact with something that activates a network in a selective way, like what you get from a video game.

Tim Ferriss: And the Modafinil, of course – well I shouldn't say "Of course," but I believe originally Provigil designed it as an anti-narcolepsy drug.

Adam Gazzaley: Yeah.

Tim Ferriss: Funny how many sprinters had prescriptions written for narcolepsy when that came out.

Adam Gazzaley: Now it's more broad than that. Now jet lag is on the list.

Tim Ferriss: Now jet lag.

Adam Gazzaley: And shift workers.

Tim Ferriss: Do people at this point understand the mechanism of action, Modafinil?

Adam Gazzaley: I'm not an expert in that. But I don't think that we fully understand the mechanism of action. I remember: when I first started putting it on my list of things to prescribe as a neurologist, we didn't even know what receptor systems it acted on. It was just like: "We don't know. We found this by accident, but it doesn't seem very

dangerous." As a matter of fact, it is pretty low in adverse effects and addictive potential, so it's a pretty good one.

But now, from doing some reading – although we have never used it in the lab, so I haven't dived so deep – it does seem like there's a lot of receptors that it acts on. And so I would say that we probably do not have a firm idea on the intricacies of the mechanisms that lead to its effect.

Tim Ferriss: The systemic effect.

Adam Gazzaley: Yeah.

Tim Ferriss: What is the most exciting data that you've come across, or of studies, or otherwise, related to TDCS or technologies like that? And if you could explain for folks what that is.

Adam Gazzaley: Yeah. So TDCS is a technique that falls into a larger category that I call TES: transcranial electrical stimulation. TDCS is direct current. Picture a 9-volt battery, and that's literally what we're talking about in terms of: voltage and amperage is, at that level, very low. There's another related technique that we use in the lab a lot which is TACS.

So that's alternating current, AC current. And then there's another technique that's also related to this because it's transcranial, which is TMS, which is magnetic stimulation. And all of these approaches have in common the way of using electromagnetic fields to influence the electromagnetic properties of our brain under the scalp, through the scalp; so non-invasively. So not like neurosurgery or implantable electrodes, which we use also as clinical care, for example, for Parkinson's disease.

So a brain is really an electrical machine, and using rhythm as a fundamental principle. And so if we manipulate it, we can hopefully get beneficial aspects of it. You could get negative aspects as well, which is why I always feel that we're a little premature in putting this tool out there without more appropriate guidance and testing.

But I do think this has exciting potential in this field. We actually just published our first TDCS paper that you contributed to, and I appreciate that.

Tim Ferriss: Of course.

Adam Gazzaley: In several different ways. Even as a data collector. And we showed that you could get some benefits – and this was just an opening study to start getting our feet wet with this technology – in multitasking abilities over a very short period of time that you don't seem to get without it.

Now, it's very subtle, but the fact that there's any change at all in a controlled study like that is interesting, to say the least. I mean, there are many papers like this from other labs showing that you can boost certain cognitive abilities by applying low-amperage electrical fields through the scalp, either DC or AC. But seeing it from your own lab as a scientist is always like, "Hm. Interesting. It really does seem to work." And now we have several studies going on using alternating currents, where we can actually target rhythms in the brain.

Because alternating current is essentially a rhythm. So we can make an alternating current at let's say 4 hertz theta rhythm. We know that theta rhythms from the prefrontal cortex are involved in attention. As a matter of fact, that was the metric that was low in older adults in the NeuroRacer study beforehand that we normalized with video game play. So what does it mean if you're playing a video game and we have the impression from our data that boosting this level over a month is what helped performance on this and even other tasks that we didn't train on the game? Well how about if you play the game and we boost this rhythm by applying the rhythm across your scalp? Can we lead to a more rapid learning curve?

So let's say you just got back from war and you're a wounded warrior and you have traumatic brain injury and you have cognitive impairment and we have these games that target networks that are deficient in you but you need a little extra boost of those underlying rhythms, or the plasticity?

Can we use an electrical current during game play to lead to a more effective outcome? That's what we're interested in.

Tim Ferriss: That is a cool study.

Adam Gazzaley: Yeah. We're doing that.

Tim Ferriss: That's super cool.

Well, Adam, I know that we're going to go paint the town red after this, so I want to be cognizant of budgeting enough time for us to really get into trouble. But a few last questions.

Adam Gazzaley: Sure.

Tim Ferriss: One is: if you could give your 30-year-old self some advice, what would that advice be?

Adam Gazzaley: Let's see. Advice to the 30-year-old. I would say to have no fear. I mean, you've got one chance here to do amazing things. And being afraid of being wrong or making a mistake or fumbling is just not really how you do something of impact. You just have to be fearless.

Tim Ferriss: I like that.

And, last: where can people – no, this isn't the very last. That was a head fake.

Adam Gazzaley: Second to last.

Tim Ferriss: Second to last is: where can people learn more about the lab, photography, everything?

Adam Gazzaley: Yeah. So we have a lab website. The shortcut in – it has a long EDU, but: GazzLab.com: G-A-Z-Z-L-A-B.com will get you there pretty quickly. My last name, Gazzaley, made up in Ellis Island, is an entirely unique name as far as I can tell by Google.

Tim Ferriss: SEO-optimized.

Adam Gazzaley: Yeah. It's perfect. So if you search my last name, G-A-Z-Z-A-L-E-Y, you'll find tons of links to talks I've given, to my photography, to our lab website, to lots of media surrounding the type of work that we do.

Tim Ferriss: And the final question is: if you had an additional $10 million –

just came in a secret Santa envelope or whatever – what might you do with that? Because when we sit here and play on the white board, I'm always just blown away by the number of not just options but attractive, interesting, impactful options that you have. What might you do with that?

Adam Gazzaley: I would just do exactly what we're doing. I would just funnel that right into the momentum that my lab already has. You know, the things we're doing are pretty edgy for traditional scientific funding sources like the NIH, which also happens to be pretty broke right now. The National Institutes of Health is at an all-time historic low in terms of their funding of science. Not great times. So we're forced to go to nontraditional sources like philanthropy, to try to get money from people that believe in what we're doing, to do this work. This work is expensive.

We have to hire experts, programmers, and we're trying to get cutting-edge technology into the lab. And it takes a lot of money and time and expertise. And so there are things that I want to do, technologies I want to try, people I want to hire, that we just don't have the resources to do. We have the vision of what we want to do: we have more games we want to build; we want to look at how the games interact. These studies are large; they're expensive. I would just funnel it into our ongoing research program and try to get it to the next level as rapidly as possible.

Tim Ferriss: I like it. I like this plan, Adam. And the other plan I like is going to maybe go out and have some wine as our cognitive handicap.

Adam Gazzaley: Yes.

Tim Ferriss: Before we get back to the focus on cognitive enhancement.

[Crosstalk]

Adam Gazzaley: Sounds great.

Tim Ferriss: Thank you so much for the time, man. Always fun. And everybody listening: check out the lab. Check out Adam's work.

And we will be definitely following Neuro Man and the adventures of Adam and Co very closely. For show notes, guys, links, resources, etcetera, books, things we talked about, just go to 4hourworkweek.com/podcast. And, until next time, thank you for listening.

Adam Gazzaley: Thanks, everyone.