BRAIN SCIENCE PODCAST

With Ginger Campbell, MD

Episode #33

Interview with Dr. John Ratey, Author of *Spark: The Revolutionary New Science of Exercise and the Brain*

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INTRODUCTION

This is the *Brain Science Podcast* – the podcast for everyone who has a brain – and I'm your host, Dr. Ginger Campbell. On the *Brain Science Podcast* we explore how recent discoveries in neuroscience are unraveling the mysteries of how our brains make us who we are. For more information including Show Notes, links to previous episodes, and information about how to subscribe please go to the website brainsciencepodcast.com. We also have a Discussion Forum at brainscienceforum.com and you can send me email at docartemis@gmail.com.

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This is Episode 33 of the *Brain Science Podcast*. Today I have an interview with Dr. John Ratey of Harvard Medical School. We're going to be talking about the brain and exercise. I'm really excited about this interview because it contains

information that should be useful to everybody. Dr. Ratey is a professor of psychiatry at Harvard Medical School and he has a new book out that's called, *Spark: The Revolutionary New Science of Exercise and the Brain*. That's going to be the focus of today's interview. He has also written several other books including a best-seller in 2000 called, *A User's Guide to the Brain*.

Let's get on into today's interview. After the interview I'll be back with a few announcements.

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INTERVIEW

GC: I'm happy to welcome Dr. John Ratey to the *Brain Science Podcast* today. John, thanks so much for coming on my show.

JR: Thanks for having me. I enjoy talking.

GC: Me, too. That's why I'm in podcasting. I always wanted to be a writer and I could never find the discipline to actually do it; and when I discovered podcasting, now I'm spending 40 hours a week on it. So, there you go.

JR: Oh, wonderful. Wonderful. You found your bliss.

GC: Well, it would be bliss if I could actually get paid to do it.

JR: Well, that's right. That's right.

GC: To start out with can you tell us just a little bit about your background and maybe how you got interested in the relationship of exercise and the brain?

JR: Yes. I'm a psychiatrist. I was actually in medical school in 1974, but I had been working in psychiatry before that for a couple years and saw the introduction of lithium and the wonder of the new antidepressants—at that time they were the tricyclics imipramine, desipramine, and Elavil—and that was just a marvelous change from where we had been before. And so, there I am in medical school sitting and reading a paper about medical news and they say this psychiatric hospital in Norway, I believe, was admitting patients with depression and offering them a choice: either one of the new and great antidepressants or an exercise program. And that sort of stuck in my brain ever since.

And then I was the University of Pittsburgh and then came back to Boston, which then was the seat of the marathon craze with Bill Rodgers, and everyone was really all about running. And at the same time Candace Pert had discovered the endorphin receptor in the early 70's. And so, people were saying these marathoners that can run up Heartbreak Hill and push through the pain are really in this Nirvana zone; or they've discovered they've raised their endorphins in the periphery, anyway. And it actually doesn't cross the blood-brain barrier; but we do make endorphins when we're stressing our muscles, also.

But anyway, it took off and everyone was talking about the endorphin rush. And being in Boston I saw a lot of marathoners and ex-marathoners who got hurt and couldn't run anymore. And a few of them that I saw got depressed. Some were treated with antidepressants because they couldn't run anymore. And then one very successful person who I knew said, 'You know when I had to stop running I got depressed, and then after I got depressed I discovered I had ADD. I never had it before. I was always in training, always running, and always very, very focused. But since then I'm a space shot.' And so, he was one of my very first patients that turned me on to ADD in adults back in 1982 or so.

So, it began to click with me. In the 70's and 80's Duke University and a lot of other places were starting to talk about how exercise is useful for collateral

circulation in the heart, and how to decrease problems with the heart and heart disease, and all that. At the same time they started to notice that their patients not only were heart-healthier, but they were less stressed, they were less angry, they were less depressed, they were less anxious: all the things that I was studying in psychiatry. And we were thinking about it from different perspectives, but medicine was certainly one of them—using medication.

And so, it just was something that sort of ran parallel. And every now and then a new landmark study—seeming—would come out about how exercise was as good as medicine was for anxiety or depression. And it got front page news, usually, in *The New York Times* or in *Newsweek*, and then was probably forgotten. But it always sort of stayed with me that this was really something in the background that we weren't paying enough attention to.

So, I began to really focus on this as I got deeper and deeper in working with people with attention deficit disorder, and finding that a lot of them really self-treated their disorder by exercising—some two or three times a day—to help them stay focused. Then we began to see this across the board when parents would come in and say, 'When he was playing three sports and exercising every day he didn't seem to have these problems.' Or, the one semester that they were involved in sports and really exercising a lot that their problems at home with their behavior, or their grades at school would go up rather than down. Which one would think that with more time spent away from studies their grades would suffer. But, no, it just seemed to have the reverse effect. And so, this began my watch on what was happening in the world of science with exercise.

And then a real landmark study came out in 1995 in a little article in *Nature* written by Carl Cottman and his crew out at the University of California at Irvine, where he had started to look at the effect of exercise on the brain. And he really was the first person to begin to look at what happened in the brain—what changed. And he published an article talking about how the levels of BDNF—or

brain-derived neurotrophic factor—went up when he had his exercising mice vs. the control mice. It went up two or three times normal, which was linked up with the just-known fact that exercise is one way to prevent the onset of cognitive decline in Alzheimer's disease. So, this really opened the doors. Since then there's an avalanche of neuroscience reports on exercise and the brain.

GC: I always cringe when I hear someone say that they're going to punish a kid by taking away playing sports, because that sounds like a very counterproductive solution for most kids.

JR: Right, exactly. I've been very involved in the education programs around the country these days, since my book has come out, talking about this. Some schools instead of having time out have what they call time in. So, a child who's really out of control and can't be in the classroom because they're too disruptive, instead of sending them to sit in the corner or down to the principal's office and just sit and be isolated, they send them to either a stationary bike, or another thing they use is Dance Dance Revolution—the machine set-up.

And they go in there for five minutes and burn off their energy. That's what we used to say: they burn off their energy. But what they're actually doing is they're changing the neurochemistry in their brain. Because we know that when you exercise you start releasing a lot of neurotransmitters and other neuro-factors that are all useful to turn on the frontal cortex, which then inhibits lower functions. So, think of putting the brakes on the runaway impulsive amygdala.

GC: Do you want to say a little bit specifically about the relationship, especially in kids, between physical fitness and academic performance?

JR: Oh, yes. Just yesterday in *USA Today* they published an article about the CDC's new paper, that I haven't been able to get yet—it's online. 5000 children were looked at over the course of three years. And they found that—the girls

especially—the more exercise they did, the higher their marks went over the course of three years. And the boys, it wasn't statistically robust enough to make it a legitimate finding—but then there may be other issues around that.

But I think once we got into exercise and how it affects the elderly—and we know that it improves cognitive function to a great degree in the elderly, and actually causes regrowth of the brain and makes the hippocampus expand a bit as we begin to exercise when we're sedentary to begin with—but we hadn't looked at kids because there wasn't any money in it. The educational research had been pretty lousy, and it's hard to do a controlled study. So, no real good science had been done until recently, when now people are turning to look at the effect of exercise on kids and their performance and finding that you do see this boost of effect on the executive function—the frontal cortex especially—in improvement in performance, and in improvement especially in math. Which is something that's really interesting; it ties into the real executive function of the frontal cortex.

GC: When you were in medical school did you find time to exercise? Did you notice a difference in how you did when you did exercise and when you didn't?

JR: Well, I played some pick-up basketball. But we're talking back in the 70's. I wasn't in Boston when the marathon craze hit. It was only when I came for my residency, and then that's when I began to run—like everybody in my class I would imagine. Everybody was running back in '78 or so. But in medical school I really didn't do much exercising. I was a jock all my life, but then I broke my arm and I couldn't play tennis.

But I came and started running here. And then I couldn't continue the running, and I started on the various machines early on and stayed on them ever since. But I absolutely noticed an effect for me in terms of energy and vigor, mood regulation, anxiety: all the things that we know that exercise helps. And we used to think, like I said, burning off steam, or burning off all that energy. Well, it's

that, but also it's changing the chemistry in your brain. And that's what I write about in *Spark*, my new book.

GC: Right. I'm going to ask you some questions about the chemistry in a few minutes. My listeners know a little bit about it because I've introduced them to some of the neurotransmitters, but I'm going to give you a chance to tell us about some that I had never heard about. But first, another subject that I've talked about a lot in the last year because it's just one that everyone finds intriguing and exciting is the whole issue of brain plasticity. Is there a connection between plasticity and exercise?

JR: Oh, huge. That's a softball question.

GC: Yes, it was. It was. But—you know.

JR: No, that's great. It's what exercise does. As far as we know it's the ultimate way to improve plasticity in the brain for stuff available to most all of us, including people that have been looking to improve plasticity with medicines and what not. Exercise is the champ. I mean undisputed, because it causes a rise in this plasticity throughout the brain. And plasticity, as you probably have talked about on many podcasts here, is really about the brain's malleability—its ability to change—which means its ability to wire one nerve cell to another, to expand the connection, to make it fatter, and faster, and better, and to really encode that information. That's what we really mean by brain plasticity.

Then the sexy stuff comes with the stem cells that followed hard upon. In the early part of the neuroscience and exercise interest people were saying not only are we seeing that rats who we run learn quicker and better and faster, but they have more of these new nerve cells in the hippocampus. Fred Gage and Henriette van Praag did studies on it in California showing that exercise was the thing that seemed to increase the development of these stem cells into new nerve cells; even

more so when they took away an enriched environment. They wanted to compare them, and exercise even trumped that. But both together, of course, are the best. But that was a second astounding finding, really, in '98 or so when they found that.

GC: Do you want to talk a little bit about the neurotransmitters and other chemicals in the brain?

JR: Sure. There are a whole bunch that exercise pumps up, partly because of the activity of the nerve cells that is going on. All the nerve cells seem to be activated when we're exercising. And some more than others, but all of them are at play. And so, what you get is a lot more of those chemicals that we as psychiatrists are trying to influence with all of our medicines—dopamine, serotonin, norepinephrine, GABA—all of these are, for that moment, increased; some lasting for varying lengths of time. And so, you see after a bout of exercise people having better focus, which comes from the dopamine and norepinephrine, and feeling more vigorous, the same two. Also they're less impulsive, less fidgety, their mood improves, they're more confident, even, and more motivated.

All of that is a lot of different things, but certainly our friend that we came to know and love with the Prozac revolution—serotonin—is increased immediately, and then more so over time as we bring in more building blocks for it. If you're really exercising you boost your serotonin levels. As somewhat of a psychopharmacologist in my distant past, we always were targeting and worrying about those particular neurotransmitters. And most, if not all of our drugs affect those neurotransmitters in some way. And so, I say a bout of exercise is like taking a little bit of Ritalin and little bit of Prozac in just the right area of the brain in a very holistic, non-side-effect manner, so that you get then a more contained and focused individual.

GC: I think I discovered this intuitively when I was a teenager. And like you mentioned, a lot of your patients discovered this on their own too, didn't they. But now we have the science to show why it works.

JR: Exactly. And then, just to pick back up on that, our mood is improved too with these neurotransmitters. And as I say, we used to think it's the big rush of endorphins. Well, it's pretty hard to get your brain to release that much endorphins. We do when we're exercising a little bit. But it's only those people who really can go for 45 minutes flat-out that I think get this endorphin rush where they really are in the Nirvana state and they don't feel any pain. And they end up injuring themselves, usually, because they're not listening to their joints as they're stressing them.

Another newer neurotransmitter on the map is the cannabinoids, or the marijuana factors that we have both in our body—and released like endorphins in our body—and in our brain. And these marijuana factors—which are still hard for me to pronounce; they're weird names—really also help improve the mood and decrease pain sensation peripherally and centrally. So, they, combined with the soup that you're making during and following exercise, have a very nice effect on the reward and pleasure and satiation centers, as well as turning on the frontal cortex which allows us to cognate better and adapt better to the world.

GC: What about something else you introduced in your book, which was the neurotrophins?

JR: Yes. Now, that's the big new news I think that really got people excited, and which Dr. Cottman really showed in '95—that exercise increased these neurotrophic factors. There are a bunch of them but the Queen of them is one called BDNF—or brain-derived neurotrophic factor—which I called, and I think probably he called at one point, Miracle-Gro for the brain; because it's literally fertilizer for the brain. It helps everything about growth in the brain that

happens. It fosters growth and development. So, we're talking here of nerve cells that are buffed up by it. Also it makes fertile ground for the development of our stem cells into healthy involved nerve cells, which they can turn into even in us humans—which was a huge debate following the discovery.

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JR: These neurotrophins are brain growth factors that have a wide range of effects and help our plasticity maintain itself and get better. And what's really fascinating in the last four or five years in my field in psychiatry, we're looking at depression a little bit differently than we were even five years ago when we were talking about changing the serotonin, and dopamine, and norepinephrine levels. But now we're thinking more along the lines of what we're really doing. That's sort of part one. Part two is that we're increasing—with antidepressant action—we're increasing the level of these neurotrophins; especially BDNF. And this goes along with us now looking at the brain as losing its neuroplasticity a lot if we're in that chronically stressed state of depression. And our antidepressants, as well as exercise, cause this whole scenario to get reversed.

GC: I'm going to come back to depression specifically a little bit later, but I wanted to sort of take a different tangent for just a minute. You mentioned in your book that some scientists—and I've read this in other places—think that our brains are evolved to support movement. Would you like to say something about why this is important?

JR: Well, I think people need to sort of rethink about the split brain as what I call the front and the back brain. The back of our brains from the sensory cortex back is all about input. And the forepart of our brain—or the front part of our brain, in front of the motor cortex—is all about movement and guiding movement. And from that has evolved—after many iterations of cells or groups of cells that are affecting better action of cells already there—as we evolved we

laid on more and more layers of nerve cells that made our frontal cortex and got to the point where we could think abstractly, where we could remember and therefore have a history, where we could plan, we could sequence, we could rehearse our movements to be moving better. And eventually we end up writing poetry, and talking philosophy, and solving equations, from the evolution of our nerves in our brain to move better, to be a better actor out there.

Since we get into the what I call the heavenly heights of the brain we don't think about that as somehow related to movement: that our actual thinking–and what Linnaeus said about even consciousness—that thinking and consciousness is the internalization of movement. It's sort of taking the fact of movement inside of our brains. Which I think is a lovely way to think of it.

GC: And do you think that this might be at the root of why exercise stimulates BDNF?

JR: Oh, yes. I think there's a big part of that. And what I loved so much in doing the book – even though it was a labor of love, it took a lot to read all the neuroscience that I had missed. Because I wrote a book that came out in 2000 called *The User's Guide to the Brain,* but there's so much more, and so much more intricate, that has come out since then that it was quite a learning process for me. And what I came up with—in the stress chapter especially, and then in the aging chapter—is that stress is the demand for our cells to react and respond, and then when we have a recovery period we get growth. And it's all tied up with cytokines and with stress hormones like BDNF, endorphins, etc.

Stress is really good for us. And when you're running you're stressing the brain. Well, the difference between stress and what most people think of as stress—and then everybody's trying to make up new words for different kinds of stress, which miss the point, I think—what we would call toxic stress; that is, stress that doesn't end or doesn't have a recovery period. That causes the real problems. And that

not only doesn't grow the brain, that eats it away; you get brain erosion that you see in depression and other heavy stress-related disorders.

So, what I learned, and think is really what evolution is saying to us, is that if you are in a situation where you're continually being challenged you will continue on the growth curve, more or less. And of course the genetics obviously enter into this, and other factors, and all that; and then inevitable aging—you can't live forever. But the more that you do this stress inoculation for each cell in your body and your brain, the more you're saying we're still out there on the hunter-gatherer plains, we have to go forage now for our 12 miles a day—which is what we did back then when we got our genetic load, pretty much as it is today—we're still active, we're still moving.

And one of the reasons why I think you deal with aging better if you're moving is that you're tricking yourself; you're tricking your brain, if you will, into thinking that you're younger and that you need to grow, as opposed to being stationary and having the atrophy occur as it does. So, I think that's the way I see the whole process sort of coming about: if you need it, it will come, almost, and within your own lifetime.

That's the amazing thing about our plasticity. You learn, learn, learn and you develop new pathways and push your nerve cells to help deal with it. And so, that's where I think BDNF comes in. It's one of those stress hormones. And I think of it as a stress hormone. I mean I love the way that sort of plays. In other words it is released when you're stressing or when you're acting—when your cells are acting, when your brain cells are acting—but then in the recovery period it helps preserve those cells and make them tougher.

GC: You alluded to something else a little while ago I want to mention. My listeners are familiar with the idea of environmental enrichment stimulating

brain growth, and the experiments that you talked about. Would you say a little bit more about how these same principles relate to the effects of exercise?

JR: Do you mean the difference between environmental richness and exercise?

GC: Is it because they have a similar effect on the brain?

JR: Well, I think environmental enrichment obviously has lots of effects on the brain—I mean in brain growth and all of that. And here's a big part of the difference. I'll go to one thing that people always ask about. If exercise makes you so ready to learn, why do we still have dumb jocks? OK. Because they're choosing not to get into the enriched environment that they might be in in the classroom—if in fact it is an enriched environment—they're paying attention to something else. Or, they have some other deficit that keeps them from picking up the information. Or, as I say, they're just not interested in playing with the toys in front of them—if it's the ideal school setting, let's say.

So, you need that enriched environment to do this activity-dependent learning of your brain cells that you've made better, made more ready, optimized into a situation where they're ready to bind, they're ready to be more plastic. But you have to have something to put down, or to learn, or to be interested in and excited about for that to really bind and take place. Otherwise you're just drifting off into Never-Never Land.

GC: So, exercise is good, but then you also need some mental enrichment, so to speak.

JR: Oh, absolutely. You know with Carl Cottman's first studies back in the 90's, they did a large study looking at what were the factors that prevented the onset of Alzheimer's and cognitive decline. Well, there were three. One was low caloric intake—which no one likes to talk about, because it really means low caloric intake and we all like food. And then continued leaning. And exercise. And

exercise was the odd man out. People were already familiar with the learning issue and also the caloric restriction, but really didn't know what to make of exercise. What does it do, just make more blood available, and collateral circulation, and all that? That's in part true, but they pressed that further.

And then one thing that all three prevention factors share is that they're all about stress. Low caloric intake—not enough food, quite—is a small stressor all the time. Learning—what does learning do? That means you have to use your brain cells in a concentrated kind of way, which means they burn fuel, which is stress. So, you stress them, they wire together, and then in the recovery period they grow, and they grow healthier. And the same way with exercise. So, there is this sort of overlapping parallel that you see.

And in my chapter on stress I say basically stress is good. And most of us have the negative form of stress on our minds when we talk about stress. But it's what we do all the time: if we're talking, if we're moving about, if we're doing most anything except watching "Law and Order" again and again and again.

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GC: There was one question about stress that I had that you haven't already answered. That has to do with the role of glutamate. I wasn't really clear on exactly what that does.

JR: Well, glutamate is our most common neurotransmitter. The biggest proportion of our nerve cells use glutamate, because it's really the messenger. All these other things—dopamine, serotonin, norepinephrine, and GABA even—they're all modulators. They affect transmission of the impulse across the synapse in some way or another. Well, glutamate is the messenger. It's the thing that goes across and starts to play, and everything else affects that. So, glutamate is very, very important, and it increases when we exercise.

And the problem is when you're in a high stress situation where there's no recovery you get too much glutamate going all the time, and that can become neurotoxic and we begin to see erosion take place. But it is a very important part of the whole puzzle. It gets little mentioned because there's too much of it. Even in psychiatry we're just beginning to look at medicines that alter glutamate, because it's everywhere and it's really the responsible neurotransmitter for almost all of our nerve transmission. So, to mess around with that you're affecting almost all the cells in the brain.

GC: Would it be fair to say that the overall effect of exercise is to help get all these different chemicals balanced out correctly?

JR: That's the way I see it. I really see it as bringing about some kind of better equilibrium state where they're more in sync with one another, if you will. For instance, the story with norepinephrine, that we know with exercise you increase the amount of epinephrine that you release. But over time you make the norepinephrine nerve cells better at responding to stressful situations—meaning when you need it, it goes, but you don't overrespond. So, you change the dynamics in the midbrain, really.

And that is the starting engine for keeping us awake and aroused and all that, and it's also the starting engine for the sympathetic outflow and for the arousal response you get when you're stressed. That being pressed too often really leads to a chronically stressed state. So, exercise is what I call a stress inoculation. You inoculate the brain, both in this overall level and within the cell itself, that you change the dynamic so you begin to make yourself not so over-responsive, yet when the response is necessary, bang, you're on it.

GC: OK. There's one other question about glutamate that I can't resist asking you. I personally try to avoid NutraSweet because I know that its main metabolite is glutamate, and it seems to me that eating something that's going to

be adding excitatory neurotransmitters might not necessarily be the best for my brain's balance.

JR: Right.

GC: What do you think?

JR: Yes, I think it may have something to do with that. I mean I'm not familiar with that science, but it certainly could be at high enough levels. That's what I mean, the glutamate is toxic. It's one of the neurotoxins. It's why our brain cells die—it's overdone; there's too much going on and not enough modulators, or too much information going on all the time.

GC: Going back to BDNF for a minute—since it's sort of the star of your book, I guess—since it's made by the brain, why is it that we have to have exercise – do we need exercise in order to be able to use the BDNF?

JR: No, no. We're making BDNF all the time. When we're learning, when any of our cells are working we make some BDNF. It's just when we're exercising it pumps it up big time. Serotonin-type antidepressants increase BDNF, lithium does, Depakote does. A lot of our psychiatric drugs increase this BDNF, but nothing trumps exercise because it does it all over the place in the brain.

GC: I was thinking you mentioned IGF –

JR: Oh, the IGF1.

GC: Yes.

JR: The insulin growth factor. Yes, that's a very important player amongst all of its friends. And there are a bunch of them in my book that I talk about: IGF1, FGF2, VEGF, ANP, there's a lot of these names; and I really hate to pronounce

the names even. But they all have important roles to play. And IGF1 comes from action in the muscle and action in the brain also—because it's made up there too—but not nearly as much as it's made in the periphery, and especially if you're exercising.

And IGF1 helps insulin work. We used to say that it helps you make more insulin receptors, but we're not quite sure that's true; it has its own receptors. But it certainly makes the flow of fuel into the cell much better, much more regular, and it has a lot of good effects on keeping your glucose levels at a normal level. And it also has many different roles in the brain; not so much in terms of fuel, but in terms of promoting the binding of one cell to another. It serves as a bit of a fertilizer itself in terms of making our new brain cells, keeping it alive. And these factors come up from the body, a lot of them. And this one does. It's able to pass through the brain-blood barriers.

GC: And that's in contrast to the endorphins, which early on were getting all the hype but actually can't really get into the brain.

JR: Yes, exactly. Exactly. They got all the hype. What fascinates me is, for instance, there are two that I mentioned—the VEGF and FGF2; one is vasoendothelial grown factor, the other is fibroblast growth factor—and these are made a bit in the brain but a lot of it is made in the body. It's made when you're stressing and straining your muscles—you're causing these factors to be released. And these are what we call mitogens, that cause our fibroblast cells to start dividing, because when you're stressing your muscles it's saying, 'You're breaking things here, you've gotta add some stuff on top of it.' And you start the process of cell dividing so you can replace what's broken or add to what's already there because you need more.

And the same way with the VEGF, which lines the inside of our blood vessels. So, when you're making new capillaries because you're stressing that muscle cell,

you're releasing this VEGF which starts those cells that are able to start dividing to reproduce and make more vessels. We know that these little guys—these factors—are really important for brain health. The mitogens are the factors that turn on our stem cells to divide.

One of the earlier findings—which may or may not be holding today because everything is changing so rapidly in our science up there—is the way a stem cell gets into a nerve cell is it has to divide first and then travel up into the hippocampus and become part of the hippocampus, if it's lucky. But it has to divide first, and these little factors from the body are important to signal, OK, it's time to divide; get off your butt, you stem cell, divide, and then move on your way up into the brain to sink into the hippocampus. And to me this was just marvelous because in psychiatry, the brain, the body, the mind, all this when I was coming into it was exciting and interesting, and here was the entry of the body: things actually being made in the body that affect the brain, that affect our ability to learn and our mood states. It was amazing to see it now in fact.

And I want to talk about another little guy, another little factor called ANP—a protein that's made in our heart's atrium. More of ANP is produced and released as your heart beats faster. Its job is to swim its way up to the brain to our hypothalamus to regulate it—to turn off the stress response, if you will. It helps to tone down our over-stressed state. When your heart's racing so fast, you're making more of this ANP, it has to swim up to the brain to have its effect. Which is just phenomenal.

And if you block it in some people—you just block it from entering the brain—you get panic disorder. So, you get full-fledged fight-or-flight really quickly and you don't have the brakes on as much as you would have before. It's quite astounding to think the connection between the heart and the brain and mind is coming to bear, and we no longer can think of our brain as this detached organ—three pounds on top of our head—it's really part of the body and part of our being.

GC: So, it's totally a two-way street.

JR: Exactly; in that they're interactive and one informs the other, and it's best to do both together—you know, keep both healthy.

[music]

GC: In your book you have chapters devoted to all the major problems that people that aren't like schizophrenic or something tend to know about—like anxiety, and depression, and attention deficit—and you have presented the convincing evidence that all these conditions can be improved by exercise. Why do you think it is that very few doctors really seem to know about this?

JR: Well, I think it's a matter of advertising. I really do. I think that in 1999—and since I was following this stuff and starting to talk about it in my books—in 1999 there was a very good study that came out of Duke University. It was a very well controlled study, although they didn't have a placebo group and that's what their big criticism was. But they entered about 150 patients who were depressed and had a Hamilton depression score which meant that they were clearly depressed. And three different groups were made up: one getting increasing doses of Zoloft, one with an exercise program 4 times a week 40 minutes of moderately intense exercise, and one a combined group.

Well, at the end of six weeks they all dropped their depression scores to about the same level, and they stayed there. And at the end of six months when they followed these people up, those who were exercising and stayed exercising had a better outcome than those on medicine. Now, we all know as doctors that people on medicine tend not to stay on their medicine all the time. That's one of the biggest problems: they're not always taking them. So, that might contribute, too. But with the exercise program it's something that they were measuring, so they knew that that was happening. But that came out. As I say, that made big news.

Everybody knew about it for the moment. It was a flash. But it's not like you have Madison Avenue behind it.

GC: And the drug reps aren't going to be bringing that paper to your office.

JR: You'd better believe it. You know Lilly is not going to want to talk about that, or Pfizer, or anybody. I'm trying to work with Nike to get them interested in it. But I don't have a high enough jump, or whatever. I don't know.

GC: I think at this point you've probably convinced all my listeners that they need to exercise more. So, can we talk practical?

JR: OK.

GC: You have, I think, a chapter at the end of the book about sort of advice of exactly what kind of exercise we need. And let's just talk about, say, normal people that don't have any major problems. Especially I had in mind explaining why different levels of intensities have different benefits.

JR: Right. Well, I think the intensity duration issue in exercise really plagues both the cardiologists and the kinds of psychiatrists like myself who urge exercise as a treatment, because there are not good answers to the question about what you need to do. And they're starting to look at that. Again, it's not like you have a drug company supporting research in this area. You have to beg and plead with NIH, or donors, or some people to really look into this whole area in any intense kind of way.

And it's very expensive. And how do you come up with a control group? How do you get people to stretch for three months, for God's sake, as a control group? You know? Think about it. Four times a week stretching—new stretching maneuvers. It just boggles my mind. But they're doing it. They're doing it. And they're trying to come up with the real science on how much you have to do.

The rule that I tell people is if you follow what Health and Human Services has now proposed for us—and that is about 4 to 5 times a week for 40 minutes at least, at a brisk pace of walking, getting your heart rate up to 65% max heart rate—not only will you be healthier in your body, but your brain will be in very good shape, and preventing the cognitive decline that besets and waits for us all. That's the sort of standard dictum. And as you get older you should be doing more, because hopefully you'll have some time to do more, and make it a part of your day.

Certainly the biggest problem is starting an exercise regimen. And it's shown that people who really get into it, even, 50% of them after six months will have stopped because it's hard to do. It's hard to keep at it. So, if you can play a sport along with it, if you can be a partner with someone—which is very important; by the way, that's even more of a boost to the mood if you're walking with somebody, or running with somebody, because of the social interaction—it'll keep you more honest. So, these walking groups in neighborhoods you see, or running groups, or joining a team—even when you're 55 or 60 like me—joining a team to play that gets you there, it gets you up, you don't think about it.

I played squash for almost 30 years, until I ruined my rotator cuff. I can't do it anymore. But three times a week for 45 minutes I was running flat-out and I didn't even notice I was exercising. I didn't think of it as exercise. It was just fun and competitive. So, if you have that kind of sport, then that's the kind of thing you want to do. It can be golf—if you walk the course and not ride the buggy—or most any of our movement sports are very good ways of raising your heart rate without even thinking about it.

GC: So, if a person has a pretty good core exercising like a lot of people do now—I guess a relatively lot of people will walk regularly or do something like that, and that's aerobic—is there a special benefit to actually kicking it up a notch? Maybe even getting into an anaerobic range?

JR: Yes. Well, that's what for me was the new stuff. And I say that pretty dramatically, I think, in my last chapter there. When I was doing the work for this book and reading all the new papers that were out there, there was a bunch of new stuff that wasn't new to some people probably, but we knew that when you really go, when you do real hard intervals, it changes what's going on in your brain and what's released; which is really quite amazing. And if you do flat-out exercising to exhaustion, or even for 20 seconds, and you do this repeatedly through a 20-minute workout period, you're going to release not only all the great things and change the dynamics in your brain, but you're also going to release HGH—or human growth hormone; or Roger Clemens, Barry Bonds hormones.

GC: Legally!

JR: Yes. Legally. Most of us, when we hit 30 it's gone, essentially; it's out of our lives, because we don't need it anymore—and I'm still looking at it from an evolutionary perspective. But when you really stress and strain your whole system, not only you might get the endorphin rush if you continue for a long time, but this bolus of HGH is released and continues to be released for a period of time after you've completed your very, very fast intervals—and I mean to exhaustion.

And that's where the studies were done, and they were done with younger guys and gals, actually in their middle age, that were hooked up at the University of Virginia. And they measured that once they did even one 30-minute period of acceleration to where they were panting and holding on, this caused a gradual increase in the release of HGH for up to the next four hours. It continued to increase. Now, what's great about HGH is why the movie stars take it and have been taking it for years, and why athletes take it. It really does melt the fat and make it into muscle; and especially the belly fat, which is the problem for most all of us as we age. We sort of save our stores of food for the ready, only we don't really need that much.

GC: But this is not something we would do every day.

JR: No. Oh, my! If I do it twice a week, and I'll do maybe three or four episodes of running on the treadmill—I try to get up to 30 seconds—it's very exhausting. But when you're finished, when you make it out of the gym, you are really turned on like nothing else. It's really quite an amazing feeling. And it has a lot of other helpful factors like releasing nitrous oxide and all this other stuff, which helps improve your vasculature as a whole. But it really does, I think, a wonderful job on the mood and alertness, and certainly does all the good things for your body and brain.

[music]

GC: Well, I have to say I've had a lot of great guests on my show so far, but I think that you're going to get rave reviews for giving people something that they can use. Because I get a lot of emails with questions of, 'Should I go and do this program on the Internet to make my brain better?' There are a lot of those out there, and I don't really know enough to give them advice about any of that stuff. Do you have anything else you'd like to share before we finish up tonight?

JR: Well, I'd just like to invite people—especially people listening to your podcast—to come to my website, www.johnratey.com because on that is an up-to-date list of articles, resource lists, and the bibliography from my book. So, you can find under the resources slides from the many lectures I give, and all kinds of goodies, as well as recent articles and facts about where I might be teaching, or offering courses, or what not. That's a resource, I think, for people who are listening to this podcast.

GC: Right. And I will be linking back to that website in my Show Notes, so they'll be able to get there even if they don't remember how to spell your name.

JR: Good. Well, get the book first. That's the thing.

GC: I'll be linking to the book in the Show Notes, too. Don't worry.

JR: I know. I'm sure of that.

GC: Now, I have a Discussion Forum for the *Brain Science Podcast* and we usually have some discussion on each episode, so I'm sure there'll be some discussion on your episode, which will be out in a couple weeks. Somebody posted a question today about something they saw about a meta study about problems with the serotonin reuptake inhibitors and their alleged lack of effectiveness. I don't remember exactly where the study –

JR: Oh, no, that's a *New England Journal* article about three or four weeks ago now—maybe a month.

GC: They were referring to something that was posted on the peer-reviewed open access journal, but it's probably the same article.

JR: Or similar findings; you know, it might not be the same article. But basically they're showing that—I think these numbers are right—of the 100% of studies done for approval of the new drugs, only 51% of them were published. And among the 49% that weren't published, most of them were negative outcomes.

GC: Well, that's no news to doctors. I mean we know they only publish the positive studies.

JR: I know, but for antidepressants—and this is what always surprises me—when you really look at the science of what we're talking about in using an antidepressant vs. a placebo, the placebo effect for someone with depression you'll get a 30% response. OK? And partly because that's the way depression goes: it comes and goes. It's sort of part of the natural cycle—I mean of a depression. With treatment most of the time you're getting 49% remission, or not even looking for full recovery, just dropping the depression enough so that

you can begin to function. And that's pretty standard. So, you're talking about a 19% difference.

Now, with exercise you get about a 45% effect. So, it's a little less robust, maybe, than the antidepressants, but it's still in the ballpark. And it may be you have to add into that bonus of using exercise instead of an antidepressant—if that's what you do—the feeling that you're the one who changed it. And this is where our psychology comes in. It's not just about chemistry, it's about our own perception of ourselves as being the agent of change, which I think is so marvelous about what exercise does for us.

GC: And of course it's not an either/or choice. For somebody who has severe depression it might be both would be the best.

JR: Oh, yes; even mild depression, because that's a hard thing to bear, if you're depressed. And it's hard to get moving unless you have a good support system; to get yourself out there and continue to move. I'm not what we call a psychopharmacologic Calvinist—that is, don't take any medicine. No, I'm quite the opposite. But also recognizing that medicine has its limits and that there's a lot to be said for you being your own agent of change—which sounds all great and dramatic, but it's true. It's true.

GC: It seems like with all the over-hyped attention that these drugs have gotten —I mean the popular press has exaggerated their effectiveness—it's not surprising that there's now a backlash.

JR: Yes. I think it's not surprising, and there certainly has been a bit of a backlash. That started almost immediately, though. But there are so many good things that they do, too, and so many people have been helped. Then that's the added caveat. I mean you don't throw out the baby with the bath water. You just recognize that there are limits to their efficacy and that if you do what your

mother or grandmother told you—you know, go to bed early, eat well, and exercise and go out and play all the time—then people will be doing a lot better than they might be doing now.

GC: I'm a few years behind you, but not that far. I started medical school in 1980, so I remember when we first got the serotonin reuptake inhibitors. They are such an improvement over the earlier drugs—which you were in school when the ones before that came out—and as an ER doctor I'm so grateful for these new drugs because there's nothing worse than having to treat somebody with a tricyclic antidepressant overdose. That's no fun at all.

JR: No, no, no. That's right. You know the only way you can die from an SSRI overdose probably is to have a couple of tons of it fall on you or something. That's one of the big things. Back in the day I saw a number of tricyclic overdoses. Although that's not the worry. I mean in the past six or seven years the studies looking at the SSRI's vs. our old tricyclics, it's an even horse race, if not the tricyclics are a little better for more difficult to treat depressions. Except that you have that worry that you faced all the time as an ER doc, for sure. You can't undervalue that, either. It can lead to death if you do overdose there.

GC: And those are the people that are the risk, because being depressed is probably the most common reason for people deciding to try to overdose for suicide.

JR: Oh, sure. Sure.

GC: Thank you again for coming on the podcast. I've enjoyed talking to you. I would love to have you back on the show in the future to tell us about attention deficit disorder, because I have only recently come around to realizing it really exists. I still tend to think that there are a lot of people around using it as an excuse.

JR: That's the way a lot of people have thought, and think; and sometimes they're right. But a lot of the times a diagnosis is really right on and it really changes lives. You know I've written three books about it, and really see it as a major useful change in the lives of many people.

GC: You're talking about using exercise?

JR: Well, no, not using exercise. I'm talking about using stimulants to treat ADD. You know, just to be aware of what attention deficit disorder is.

GC: And it is real and a treatable condition.

JR: Oh, yes. Oh, yes. And it's real, and it destroys people's self esteem, families, whatever. So, it's been there and we need to be aware of it. If we were moving our 12 miles a day that our forefathers did on the plains we might not have the ADD—I know we wouldn't have it nearly as much as we do now. But then we wouldn't have depression as much, or anxiety, or heart problems, or diabetes, or obesity certainly. So, you'd be looking for a job, and so would I. So, there you go.

GC: Thanks again, John. I really enjoyed talking to you.

JR: I enjoyed talking to you. And now I've found a place to get some really good podcasts. So, I'll be there.

GC: OK. Thanks a lot. Bye.

[music]

I hope you enjoyed this interview with Dr. John Ratey of Harvard as much as I did. Reading his book, *Spark*, inspired me to reinvigorate my own exercise habits. Even though I do play tennis several times a week, reading this book helped me appreciate the importance of other levels of intensity of exercise. And

I really do hope that I'll be able to get Dr. Ratey back on the show in the future, either to talk about attention deficit disorder or to get an update on the latest research on exercise and the brain.

If this is your first time to listen to the podcast I hope that you will consider subscribing. And if you're a regular listener I hope that you will consider copying this episode—maybe even onto a CD—to share with your family and friends.

The first announcement that I need to make is that at the end of the last episode, which was Episode 32 about anatomy, I announced that I was going to put illustrations up on the website, and those are now available at brainsciencepodcast.com. I've also made an enhanced version of the podcast where you can see the graphics either in Quick Time or in iTunes. I'm working on getting this actually into the feed. If you get the feed, hopefully by now that episode will also be in the feed, so you'll want to look into the feed for that. If you're not getting it in the feed there is a link to the enhanced version on the website. You probably won't want to be bothered with this unless you're using iTunes or an iPod, but I do have the really nice illustrations up on the website.

I love to hear your feedback. I like to encourage people to post their comments up on the Discussion Forum at brainscienceforum.com. I also want to thank everyone who has sent in contributions to help support the podcast. And I'd like to remind you that you can help the *Brain Science Podcast* grow in many ways, including blogging. One thing that I always forget to ask for is for reviews up on iTunes. So, that would be great.

As always I almost forgot to mention my other podcast, which is *Books and Ideas*, which is available at booksandideas.com. I have a new interview coming out on that podcast. It should be out within the next week or so.

Thanks again for listening. I'll be back in a couple of weeks with an interview with Rachel Herz, author of *The Scent of Desire*. We're going to be talking about the sense of smell and its unique relationship to our brains.

In the meantime I'd like to encourage everyone to make more time for regular exercise in your life. I get a lot of emails asking me about these various programs on the Internet for improving brain fitness, and it's really unclear how effective these are. But the evidence seems to be overwhelming that exercise is good for our brains. And don't forget to share this important information with your friends and families.

Talk to you again soon.

[music]

Transcribed by Lori Wolfson
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