In These Times, Season 3 | Your Brain on Drugs (Episode 4)

Alex Schein:
The vastness of scientific information can cause us to look up at the stars with awe, but can also cause other reactions, like skepticism and disbelief, denial and discomfort, and even fear. On this season of the OMNIA Podcast, we talk to scientists and other scholars about scientific ideas that cause big reactions. We’ll look at stories of science getting knocked around and standing back up again in a world full of polarization, politics, misrepresentation and simple misunderstanding. Welcome to In These Times: Fear and Loathing and Science.

Charlie:
You're going to do something to my head. You're going to put a computer in or something.

Speaker 1:
No, Charlie, it's already inside your head. You see, we just have to make it work a little better.

Charlie:
My brain?

Speaker 1:
Parts of your brain, Charlie, millions of little parts of your brain. These parts are called chromosomes and enzymes. Genes.

Mr. Spock:
Have you noted evidence of unusual powers?

Speaker 2:
He can control certain autonomic reflexes. He reads very fast, retains more than most of us might consider usual.

Captain Kirk:
Mr. Sulu?

Mr. Sulu:
Mitchell's ability is increasing geometrically. That is, like having a penny, doubling it every day. In a month you'll be a millionaire.

Mr. Spock:
In less time than that he will have attained powers we can't understand and can't cope with. Soon we'll be not only useless to him, but actually an annoyance.

Speaker 3:
When he told me about this amazing new drug I was like, "Down the hatch!" And it was. It was amazing. I read Brian Greene's *The Elegant Universe* in 45 minutes and I understood it. My work rate increased just insanely overnight and my boss started to hate me, but I got scared.

Speaker 4:
Why?

Speaker 3:
Because I'm not stupid. Nobody can operate at that level of mental activity and not crash.

Alex Schein:
The thought of tinkering with our brains makes a lot of people nervous. That includes science fiction writers. From Star Trek to Flowers for Algernon to Limitless, enhancing brains usually leads to disaster. But new medications, treatments, and implants have helped thousands overcome ADD, ended seizures, and even show promise for restoring memory loss to brain trauma. How do we make sure we use this power for good?

In this episode we talk to Martha Farah, the Walter H. Annenberg Professor in Natural Sciences in the Department of Psychology. Farah directs the Center for Neuroscience and Society, a group of faculty and students from departments spanning the school of arts and sciences, medicine, law, Wharton, and engineering and applied science. Their work addresses neuroethics, which are the ethical, legal, and social implications of neuroscience. Farah has spent her career researching cognitive neuroscience. She received the 2021 Howard Crosby Warren medal by the Society of Experimental Psychologists for her foundational work in that area.

Martha Farah:
What I try to do in the area of neuro enhancement is both find out scientifically what these supposed enhancements do for the brain... And I say supposed not to imply that none of them work, but it's an open question, so I want to find out. Are they helpful? In what ways? For whom? And at the same time examine the ethical, legal, and societal issues that they raise. And I think those two strands go very well together. I think it's a problem when people do a lot of ethical analyses without having any idea what these things actually do or don't do. And I think it's a little crazy to move forward, trying to understand and maybe improve enhancements, without thinking about the societal impact.

Alex Schein:
Professor Farah works on problems at the interface of neuroscience in society, including the effects of childhood poverty on brain development, the expanding use of neuropsychiatric medications by healthy people for brain enhancement, and the ways neuroscience is changing the way we think of ourselves as physical, mental, moral, and spiritual beings.

Martha Farah:
Over the decades that I have been working in the field it has matured, as you would hope a field would do in four decades. But with its maturity has come new capabilities that actually do have societal implications. Without switching fields I got my wish. I got to work in a field that is as intellectually
fascinating as mind/brain studies are, but also a field where, for the sake of humanity, not to sound too dramatic, we really need to be thinking about what we're doing and what its broader implications are.

Alex Schein:
Humans have actually been altering our brains for millennia.

Martha Farah:
There are a lot of ways that people can enhance their brains and therefore their minds. The time-honored way is with natural substances like fermented drinks to help you relax, get a little buzz, and caffeinated drinks. Tea goes back thousands of years. And I think actually another natural product that's a stimulant like caffeine and coffee and tea is cacao leaves, which have been chewed by South American farmers and others to give them energy, bring in the harvest. So these are definitely ways that, for thousands of years, mankind has been tweaking their brain for pleasure and profit, to feel good, and to maybe get more done or unwind at the end of the day or whatever. But with the advent of neuropsychiatric medications we have compounds that are more potent. Certainly the pharmaceutical companies would like you to believe they're more potent and more targeted.

Alex Schein:
Some of these medications affect the body in many different ways because they bind to multiple receptors. Antidepressant medications can be life saving for people, but have a number of side effects. And then there are cases where people who don't medically qualify still take medicines. These include the descendant of the cacao leaves, amphetamines, which are the main ingredient in Adderall.

Martha Farah:
What so many students now call vitamin A... And those stimulants, they're intended for the treatment of ADHD and other kinds of medical illnesses, psychiatric illnesses. But lots of people have discovered that they make you feel really energized. They help you focus on what you're doing and so forth. And that's why they are popular as study drugs on campuses. That's why they're popular among programmers, long haul truck drivers, people who need to work through the night. So I would say that's a pretty common form of cognitive enhancement.

Now we're having a resurgence of interest in psychedelic drugs, psilocybin mushrooms, all kinds of other things including LSD, which is a synthetic substance. There's very exciting work being done at last, really overdue, exploring the therapeutic properties of these drugs. But small doses, what are sometimes called micro-doses, are used by some people who just swear by them. They say, "Wow, this really just adds a dimension of a verve and creativity and just life is better when I'm micro-dosing these drugs."

Speaker 5:
Lots of people drink coffee before they go to work. Of course others, believe it or not, drop acid.

Speaker 6: It's illegal, but only on Five Tonight, Cate Cauguiran on the Bay Area professionals who say tiny doses of LSD give them the competitive edge they need.

Speaker 7:
It's a very smooth awake and I feel focused and I can take away my distractions easily, much more easily than if I am just normal.

Alex Schein:
Another approach skips the substances and works directly with the physical brain.

Martha Farah:
There's so-called deep brain stimulation where an electrode is implanted during a surgical procedure into the brain and delivers tiny pulses of current that in theory act like a pacemaker for the brain. And that appears to be quite helpful for people with certain kinds of movement disorders and psychiatric disorders. So that's very exciting, but of course nobody is going to get their head opened up and have brain surgery for the sake of enhancement.

But there are other kinds of brain stimulation that don't require opening up your head and doing brain surgery. As an umbrella term we can call those non-invasive brain stimulation methods. Penn has been quite a leader in those. They include transcranial magnetic stimulation where you take a big, powerful magnet and place it very precisely, with the help of brain imaging to figure out exactly where you're pointing the magnetic field, and you project a powerful magnetic field into the brain. And if you think back to your high school physics, where there's magnetism there's current and where there's current there's magnetism. So basically you induce a current inside the head, in the brain, using this external magnet, and that has been shown to have pretty substantial psychological effects.

Alex Schein:
This transcranial magnetic stimulation, or TMS, has been approved by the FDA for the treatment of certain forms of depression.

Martha Farah:
Nobody is using that for enhancement either as far as anybody knows, just because you need access to a very big, expensive, and potentially dangerous piece of machinery. But more recently, a kinder, gentler transcranial stimulation system has been developed, and that's transcranial current stimulation... Or transcranial direct current stimulation was the first instantiation. There you get that current running through the brain by literally having a battery connected to two electrodes on the head and basically your head completes the circuit. So you got a little current running between those electrodes on your head and depending on where they place the electrodes, depending on the stimulation protocol... "Is it direct current? Is it alternating? Is it randomly alternating?" And so forth... "Where is the anode? Where is the cathode?" You can bring about different kinds of psychological effects with that. The effects are generally weaker and they're harder to target narrowly, but still there are effects and you can actually buy these systems, not that I encourage anybody to go out and do that because I'm very skeptical that they do anything for you.

But there are a lot of home and brain enhancement hobbyists sticking the electrodes from these systems on their heads and trying to use them to get whatever the desired effect is, whether it's to be stimulated like, "Oh, I've just had a great cup of coffee, except I didn't ingest any pharmacologic agent," or to relax. "Oh, I'm chill like I just had a glass of wine at the end of the day."
Alex Schein:
TMS must be done by a knowledgeable professional, but there are not serious short term side effects known for transcranial current stimulation. These approaches haven't been used long enough to know about long term effects, but Farah and others worry about well-meaning parents choosing this for their children, whose brains are much more capable of being molded, called plasticity.

Martha Farah:
So you strengthen certain pathways if they're active. Well, what happens when you're artificially activating a pathway at levels higher than the brain naturally sees? Over long term, plasticity could be a bad thing in that context. So anyway, bad idea with kids. Kind of unknown in general, but I have to say nobody's suffering yet with anything that we know of.

Drugs, it is different. The big, bad side effect with stimulants, Adderall and Ritalin... The study drugs that are most common. The big, bad side effect is addiction or dependence. They make you feel really good, most people would say. I think maybe even Adderall more than a little, but they do. It's tempting to say, "Oh, well, I'm enhancing myself cognitively here, or I'm feeling I love doing my problem set or writing my term paper, or I love doing whatever work the boss has me doing in a cubicle," because these drugs do enhance your enjoyment of what you're doing.

Alex Schein:
As a neuroethicist, Farah thinks ahead. One way she does this is through science fiction, whose creators think of possible futures for a living.

Martha Farah:
I think every scientist should seek out and read the science fiction that pertains to their area of research because inevitably, for the sake of our science and for the sake of mitigating the possible harms that it could cause society and also envisioning the possible benefits to society, we all need to be thinking about, "Where could this go? What could the effects be?" But nobody's better at doing that than a good science fiction writer.

So, I think they really help us envision what the logical consequence of what we're doing is, and by and large the literature on neuro enhancement in science fiction is all ominous warnings about what will happen if we go that route. That's a little depressing, but I have to say, first of all, we're not going to not go that route because we think something could go wrong, because we can't stop science. And if we do, if we try to unilaterally stop it, for example, in our society, other societies that don't have the same reluctance to risk humanity will go full-speed ahead. And then they'll be the ones that have this technology and then we'll really be in trouble.

Speaker 8:
A tablet a day. And what I could do with my day was limitless. I learned to play the piano in three days. Math became useful and fun.

Speaker 9:
I'm all in.
Speaker 8:
Even half listening to any language, I became fluent.

Speaker 10:
[foreign language 00:16:21].

Speaker 8:
I suddenly knew everything about everything.

Speaker 11:
Sure, you get a short term spike. But when that rapid expansion devalues stock completely in two years-

Speaker 8:
No, because there are safeguards.

Speaker 11:
Against aggressive over expansion? There aren't because there are no safeguards in human nature and we're wired to overreach.

Alex Schein:
Professor Farah loves the recent Bradley Cooper movie, *Limitless*, as well as the book it was based on, *The Dark Fields* by Alan Glynn. She recommends another book, *Acceptable Risk*, by Robin Cook, which she hates, but calls the poster child for fictional warnings about enhancement drugs. And one of her favorite books is *Beggars in Spain*, by Nancy Kress. In it, genetic engineering has advanced to the point where well-off parents have their children's genes edited to improve their brain function.

Martha Farah:
She is just super smart and, interestingly, she doesn't need to sleep so she can use her super smarts 24 hours a day. And so she and the other people who were similarly enhanced just start to clean up in the competition that is life. And what's great about the story is that it starts you off in this state of play that is not wildly implausible. You can definitely imagine enhancements or drugs or whatever that boost your intelligence, reduce your need for sleep.

The result at the end of the book is a revolution of the unenhanced against the enhanced, who they resent like crazy. And the enhanced people... They're not bad folk. They regard the unenhanced as ingrates because, well, the enhanced people are responsible for the booming world economy and for making all this great stuff.

Martha Farah:
And one thing that that novel called my attention to that I hadn't really thought about before was the economic dimension of enhancement. So obviously inequality, haves and have nots, humanity already suffers because of that. But boy, if you turbocharge the effects that we already have of better education, better healthcare, et cetera, you can imagine how just economically and politically disruptive that would be. And this story brings that home.
Alex Schein:
As Uncle Ben told Peter Parker, "With great power comes great responsibility." A recent Wall Street Journal article discussed brain enhancement projects in the works, including implants that stimulate learning and headsets that enable brain-to-brain communication. How can we prevent misuse or even just the unintended bad consequences of our quest for super brains?

Martha Farah:
There isn't a great record for industries monitoring themself, particularly when there's profit to be made. That said, people often go straight to legislating as the solution. Maybe for certain things we need to legislate. Maybe we need to make a law against employers requiring an employee to use cognitive enhancement, for example. But my guess is there are more effective and less drastic ways to get to the same outcome. Informing educators, informing human resource officials, just gathering more data.

Alex Schein:
As we begin to manipulate our own brains and try to understand the connection between mind and brain, is neuroscience changing the way we think of ourselves as human beings? One study showed a group of test subjects who read an essay about how everything we do is no more than the firing of neurons were more likely to cheat to earn money in an experiment. Other studies have shown that people who believe in free will are rated as better employees than those with a deterministic view.

Martha Farah:
It's this sense that we have free will and we're moral agents... We choose to do something that's right or wrong. That that keeps you behaving well. It keeps you on the straight and narrow. You feel responsible for your actions. Whereas if you can take comfort in the thought, "Well, I'm just a bunch of neurons. Don't blame me." You're more likely to goof off on the job, cheat in your report on how many math problems you got right to make more money, et cetera.

I have to say, first of all, these results... There's a bunch of them like that out there, but there's also a fair are failures to replicate them. So at this point I think the jury's out. It's not implausible that they're onto something, but that does point to at least one way in which it could be really bad for people to start thinking of themselves as brains.

Alex Schein:
But thinking of ourselves as brains can be good as well. We may be less judgmental if we're not assuming that someone must have willfully done a bad thing. For example, new research explaining the teen brain and how the prefrontal cortex isn't fully online until our twenties is helping parents and teachers deal with seemly irrational adolescents.

Martha Farah:
I think in terms of criminal justice, juries are more likely to show mercy if they reflect on the fact that the person did the stuff that they did because of their brain. Look at the progress that's been made in destigmatizing psychiatric illness, particularly depression. So this was, oddly enough, the result... An unintended good consequence, maybe, of the pharmaceutical industry advertising antidepressants. And they went on a big information campaign and even the TV commercials... They show the little synapse,
the little balls of serotonin crossing them, and explained that if you are feeling horrible and have no motivation, just whatever, it's a chemical imbalance, as they would say.

Martha Farah:
And I think that made people less ashamed to be depressed, which is very positive. It means they're more likely to get help and at least not feel ashamed of themselves and their friends and family can also be a little more understanding. It's a night and day shift in how we think of people and ourselves. And it certainly has a dark side like, "Oh, what does it matter? We're just a bunch of neurons. Just grab what you can get when you can get it," versus, "Be understanding because not everybody's brain works as well."

Alex Schein:
That wraps up the fourth episode of In These Times: Fear and Loathing and Science. We'll be back in two weeks with episode five, Better Living through Chemistry? We'll talk with a chemist about why people don't trust chemistry, even though it's our best hope for solving the problem of sustainable energy.

The OMNIA podcast is a production of Penn Arts and Sciences. Special thanks to Professor Martha Farah. I'm Alex Schein. Thanks for listening. Be sure to subscribe to the OMNIA podcast by Penn Arts and Sciences on Apple iTunes, wherever you find your podcasts, to listen to all seven episodes of season three of In These Times: Fear and Loathing and Science.