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ReachMD
www.reachmd.com
info@reachmd.com
(866) 423-7849

Understanding the Brain: An Exploration of an Extraordinary Organ

Dr. Wilner:
Welcome to *NeuroFrontiers* on ReachMD. I'm Dr. Andrew Wilner. And today we are going to discuss what is perhaps pound for pound, the most complex and versatile creation the world has ever seen. That's right, the human brain. Here to explain how human beings came to possess such an extraordinary organ is Dr. Bret Stetka, author of the new book, *A History of the Human Brain*. Welcome, Dr. Stetka.

Dr. Stetka:
Thank you, Dr. Wilner. I'm very excited to be here. Thank you to ReachMD for having me. And yeah, very excited.

Dr. Wilner:
Bret, I know you have written for *Scientific American* and other publications. Can you start by telling us why you chose to write a book?

Dr. Stetka:
Sure. I never actually thought I would be writing a book. And you know, I've been writing for *Scientific American* and *NPR* as well, mostly on topics around neuroscience, neurology, and evolution, which has always been another interest of mine and anthropology as well. And so when I was approached by an agent a few years ago who had read some of my work and asked if I had any ideas, I said absolutely not, I have no ideas. And I sat for weeks and just couldn't come up with anything. But this book on the heart had just come out by Sandeep Jauhar, and it was just an interesting history of how scientists came to understand the heart. And I got to thinking, has anyone ever written a layman's book about just the evolution of the brain and where this beautiful, incredible organ came from, as you eloquently put it? And so I pitched it as just let's tell the story of the brain, you know, including some science in there, some high science, but something that's accessible to anybody that's interested in science. And, you know, luckily, my publisher bought it. So Timber Press and Workman Press are my publishers, they took a chance on it. And it was a challenge to squeeze the history of the human brain to 250 pages. But it was a fun challenge, and so here we are.

Dr. Wilner:
You know, I'm a neurologist, and I thought about writing about the brain, but to me, 10,000 pages wouldn't be enough, and you got it into to 250 pages, but I'm wondering what did you discover is like, gee, you know, I didn't know that. This is worth looking into. Were there any surprises as you did your research?

Dr. Stetka:
There were, and in hindsight, it was probably very stupid to try to fit 3.5 billion years into 250 pages because I start with the dawn of life, how does the organic arise from the inorganic. But that was also kind of a fun challenge. And then, the big surprise was when you get to animal evolution, and the subtitle of the book is *From the Sea Sponge to CRISPR*. And I had no idea about this, you probably did, but I didn't pay attention to zoology. But the sea sponge is considered the first animal to have evolved on Earth about 700 million years ago. And it's the same sea sponge that people still use. You can still buy them at Target. And people use them to scrub themselves. And what fascinated me is that the cells of a sea sponge interact with each other, much like our own neurons do. They use electrical currents, ion channels, they use some of the same neurotransmitters, I believe, glutamate and GABA. So even though they don't possess an actual nervous system or a brain, they are certainly the beginning of our brain's story. And that is something that I had never heard and was completely fascinated by it when my research revealed it.

Dr. Wilner:
So maybe we should treat sponges with a little more respect, you know, as ancestors.

Dr. Stetka:
Yeah, stop scrubbing ourselves with them and put them on the mantle or something.

Dr. Wilner:
Well, I have a question. And I don't know if it's answerable or not. But when you looked at the sort of the evolution of the human brain, you know, obviously, our brain is bigger pound per pound than most other animals. But is there anything qualitatively different?

Dr. Stetka:

I think there is. I think through a lot of mammalian evolution, size was important. The brain did evolve to get bigger and bigger. And scientists measure this with the encephalization quotient, which is really a measure of how big your brain would be expected to be based on all animals of your size. And so chimpanzees have an EQ of 2.5. And we have one of seven, the highest, basically. So we have a huge brain. But our brain has been shrinking, actually, for about 30,000 years and was probably a bit smaller than the Neanderthal brain. And they died at around 40,000 years ago, so our brain was actually bigger back then. And so the theory behind that is that because our brains were restricted in size by women having to give birth to that brain like a large head, it ended up being that connectivity among the neurons was more important.

So if you look at the “intelligent animals,” most of the apes, orcas, porpoises, they have more what are called spindle neurons, which I'm sure you're very familiar with, Dr. Wilner. And they have more spaced-out cortical columns, which the neurologists will probably be familiar with. So there's these columns of spindle neurons and pyramidal cells actually in our cortex. And in us, they're spaced out much further so that you can have more neuronal connections, more synapses in between. And if you look at chimps, they have slightly less than us, but more than all the other species. So yeah, I think it has become a matter of connectivity and architecture of the brain as opposed to sheer brain size, if that makes any sense.

Dr. Wilner:

Yes, and what about the gyri, the folds in the brain which gives you more real estate? Are humans kind of at the top of the list when it comes to sort of that folding of the brain that makes the gyri and the sulci?

Dr. Stetka:
We are, yeah. As our brain grew in size proportionally to our bodies, you just had to fit more brain tissue into a skull that could pass through the birth canal. So it just got stranger and stranger looking and more sulci and more gyri were forced into a skull that then became a more plastic skull. We have these fontanelles that allow the brain to squeeze through a birth canal and be relatively soft during an infant’s life.

Dr. Wilner:
For those just tuning in, you're listening to NeuroFrontiers on ReachMD. I'm Dr. Andrew Wilner. And I'm speaking with Dr. Bret Stetka about his new book, *A History of the Human Brain*.

We live in sort of human years, right? Lifespan of 100 years, if you're lucky. But when we talk about brain evolution, we're talking about hundreds of thousands and even millions of years. Is the brain still evolving?

Dr. Stetka:
That's a huge question. And I think many scientists think that it is. Steven Pinker, the famous psychologist from Harvard thinks that it is still evolving, we're selecting against violence. And certainly atrocities like genocides and things like that will change our collective genome in a biological Darwinian sense. But I do think that cultural evolution is so much faster than biological - that's the more relevant factor. As our communication becomes digital, as kids are communicating through text and TikTok, that's going to have psychological ramifications for sure. Whether there'll be biological before the cultural changes again, and influences what we do next, I don't think so. So I think the biological evolution is slowly simmering underneath this rapid cultural change and social exchange of information.

Dr. Wilner:
You did mention earlier CRISPR. Now CRISPR is kind of like sidestepping evolution. And it's like, hey, let's just get in there, we'll make changes today that are gonna last forever, right? They're going to be inherited. And we can do it in an hour, as opposed to a million years. So what's going to happen there?

Dr. Stetka:
It truly feels like science fiction, CRISPR and related genetic technologies. As you know, in vitro fertilization is much more popular now and will become more common. And it's incredibly easy to go into an embryo now, you know, probably not you or I could do this, but the right scientists can do this. And you literally can change our genomes, to edit our genome. So if you have a disease that's caused by a single point mutation, you can go in and correct that and insert the normal gene, and all of a sudden a child that might not have thrived

or might not have lived has a full normal life. And I think that it's just going to happen whether ethically, it should happen or not. I can't imagine the parents not wanting to pursue that in a case like that. They've already used it in investigational settings in adults too to literally cure or delay hemophilia and certain forms of blindness. They'll go in an aspirate and take a bone marrow aspiration, CRISPR the stem cells, and all of a sudden you have the proper form of hemoglobin, and you can oxygenate your body again. So that's the great side of CRISPR. And then I think the dark side everyone worries about, is what I alluded to, parents or rogue scientists going in and inserting desirable traits into embryos and creating “super babies” and inserting traits for intelligence and name your trait of choice. I don't think that that's going to happen anytime soon based on my readings and research.

Dr. Wilner:
Yeah, I think it is a challenge.

One more topic I wanted to broach that you addressed in the book is food. You had some theories about how gathering food versus hunting food, how this affected brain development. Would you like to talk about that?

Dr. Stetka:
I've talked to many, many anthropologists and evolutionary biologists, and it does seem like our diet was a real big influence in our evolution, including our brain evolution. The main reason being that we were so omnivorous, which equates in a Darwinian fashion of being just more adaptable. So imagine two million years ago in Africa, our humble Erectus ancestors are evolving and they experienced many, many climate changes where things dried out, so our ape ancestors had been in the trees eating fruit. If things dry out, we're able to go out onto the plains and learn to hunt meat, we're able to dig up roots and rhizomes. As I read about a lot of us learn to access shellfish on the shore, which literally may have saved our species, learning to do that, or at least a small subset of our species. And a lot of other long distant human relatives, a lot of australopithecines, many in the genus Homo died out probably because they didn't have omnivorism, that adaptability in terms of their diet. The one factor that really comes up over and over again, whether you're a carnivore or vegetarian or pescatarian, is meat. Once we started reliably accessing meats about two million years ago, through scavenging at first and then later hunting, our brains just doubled in size. Very quickly on an evolutionary timescale. And I remember talking to Barbara King, an anthropologist at William and Mary, my alma mater, is mostly vegetarian, and she said, but we can't deny our past, and once we started eating meat, our brains just had reliable calories and nutrients. As you alluded to, the big question is, was it the specific nutrients in meats or in seafood that drove our brain evolution? Or was it just reliable calories? Which I tend to think probably a little bit of both, but once you have, say, a gazelle that you've hunted down, you've got reliable food for weeks or even months if you have fire and can preserve it. And now you can go out and pursue other things like creativity and building tools and axes and weapons. And selection can now act on these other pursuits and other characteristics and traits just because you have reliable calories. I think that was a big part of our story.

Dr. Wilner:
Well, Bret, I want to thank you for discussing human evolution and your new book, *A History of the Human Brain*. Thanks for joining us on ReachMD.

Dr. Stetka:
Thank you, Dr. Wilner, and thanks ReachMD for having me.

Dr. Wilner:
I'm Dr. Andrew Wilner. To access this and other episodes in our series, visit reachmd.com/neurofrontiers, where you can Be Part of the Knowledge. Thanks for listening.