

Speaker 1:

Welcome to Optimal neuro|spine podcast, a podcast about optimizing our brain and spine in health and disease. Each episode, leading neuroscientists, neurosurgeons, educators, patients, spine care and quality improvement experts discuss their research, experience, emerging science, surgical advances and insights about how to optimize neurological and spine care. Now, here's your host, Dr. Max Boakye.

Dr. Max Boakye:

Welcome to the Optimal neuro|spine podcast. Today we are talking about memory disorders. I have a distinguished guest, Dr. Robert Friedland. Dr. Friedland is a clinical and research neurologist who has devoted his career to the study of brain disorders associated with aging. He's a graduate of the City College of New York, received his MD from the Mount Sinai School of Medicine in New York in 1973. He completed his neurology residency at the Mount Sinai Hospital, where he was a fellow in dementia and aging at the Albert Einstein College of Medicine.

Dr. Max Boakye:

He then worked at the University of California, Davis in the research medicine group of the Lawrence Berkeley Laboratory of the University of California, Berkeley, where he served as a chief neurologist. From 1985 to 1990, he was deputy clinical director and chief of the section on brain aging and dementia of the National Institute of Aging at the National Institutes of Health in Bethesda, Maryland. At the Case Western Reserve University School of Medicine, he was professor of neurology, radiology, and psychiatry, and chief of the laboratory of neuro-geriatrics from 1990 to 2008.

Dr. Max Boakye:

In 2008, he joined the faculty at the University of Louisville as the Rudd Professor and Chair of the Department of Neurology. We're going to talk to him about his research. His work has focused on clinical and biological issues in Alzheimer's disease and related disorders. He has authored or coauthored over 220 scientific publications in refereed journals and has received sustained funding from the National Institutes of Health, as well as several foundations, institutes, corporations and families. He has received over one million annual funding to support his work from the period 1985 to 2013.

Dr. Max Boakye:

He has also completed or may be involved in a sabbatical leave in Kyoto, Japan, and this is something we'll talk to him about, where he was a long-term invitational fellow supported by a grant from the Japan Society for Promotion of Science. He worked with collaborators at the Kyoto Prefectural University of Medicine and the Kyoto Institute of Technology on the influence of microbiota on the development of neurodegeneration, using transgenic *Drosophila* models. Clearly he's an expert in memory and aging and it's our privilege to talk to him a little bit about some of these topics. Dr. Friedland, it's a pleasure to have you here. Welcome.

Dr. Robert Friedland:

My pleasure. Thank you.

Dr. Max Boakye:

So I want to start off by asking you first to describe your current clinical practice. What types of patients are you seeing? What are you doing clinically?

Dr. Robert Friedland:

I see patients with or without referral who are complaining about their memory or behavior or cognition; problems in these areas. Most of them are older than 65, but a good number of them are younger. The most recent patient I've had was 21 years old, but that is very uncommon. And many of my patients have Alzheimer's disease. Sometimes they tell me that's what they have, and they're correct, but it's not uncommon they have other diseases like Lewy body, Parkinson's, dementia and depression. Also frequently, they think they have Alzheimer's disease and they don't.

Dr. Robert Friedland:

And the main problem there is they may be old and they don't understand that the brain is aging, just like every other part of their body. And they wouldn't expect that their endurance and resilience is as good at 80 as it was when they were 40, but they think their brain should work the same. So they'll come in and say, "Dr. Friedland, I have Alzheimer's disease." And I'll say, "Why do you think that you have this?" And they'll say, "I can't remember who wrote Wuthering Heights. It was either Jane Austin or Emily Bronte, but I can't remember." And I say, "Well, that's not a feature of Alzheimer's disease."

Dr. Max Boakye:

That is fascinating. And we're going to get it into a little bit of that a little bit later on, but before we get into specifics of Alzheimer's versus aging, tell me a little bit about your current research. What kinds of studies are you involved in?

Dr. Robert Friedland:

Yes, it's kind of ridiculous that there's so much research been done about Alzheimer's disease, but we don't know why people get it. About 1% of cases have a causative gene. The rest do not. There are genetic influences that will determine your risk, but even if you have a high genetic risk, you still might not get it, so that there is some other factor, which I believe is not genetic. And our largest environmental exposure is to bacteria that live with us inside; on our surfaces everywhere, but also inside. So as our largest environmental exposure, it has a great opportunity to interact with genes.

Dr. Robert Friedland:

And my research is focused on what are the initiating factors responsible. There's a lot of work going on about what happens. You get this kind of deposit and that kind of deposit and this part of the brain doesn't work and this other part of the brain doesn't work and the whole brain as a whole doesn't work. I just saw a paper about memory; this kind of memory doesn't work. Well, we knew that like a 100 years ago, but what we need to know is why people get it, what are the initiating factors?

Dr. Robert Friedland:

And there is a view that the main factor is random, that it's a problem of the structure of proteins, the way proteins fold. They have a good way of folding and a bad way of folding, and if you happen to, by accident, get the wrong folding pattern of certain proteins, then you get very sick, you get a neurodegenerative disease. And I don't like that idea. I'd rather think that something is responsible, that there is an initiating factor.

Dr. Max Boakye:

That's very interesting. I learned during medical school that the pathogenesis of Alzheimer's was the beta amyloid protein, and there was a deposition of plaques, and that there was possibly a link to apolipoprotein. But you're touching on maybe a more proximal causative event that triggers these events. Is that what you mean?

Dr. Robert Friedland:

Yes. Specifically, we know that proteins in the gut can cause proteins in the body to develop a bad confirmation. And this is mad cow disease or bovine spongiform encephalopathy. So if you are unfortunate enough to eat infected beef, there's a protein structure in the PriOn agent in the beef which causes the PriOn protein present in the body, in the gut wall, and also in the brain, to adopt the wrong confirmation. And this progresses from the gut through the autonomic nervous system and the blood to the brain, and then it grows in the brain and then you die.

Dr. Robert Friedland:

This is established and led to two Nobel prizes already. But it occurred to me that what other factor could be responsible, similarly for Alzheimer's and other conditions, and I found that there is a similarly misfolded protein called an amyloid protein made by bacteria. It's called functional bacterial amyloid. And this is something present in the gut in many people, perhaps in everybody, we don't know. But it could have a similar mechanism in which it causes a misfolding. And there's also an immunological pathway there, where the exposure to this molecule in the gut could cause activation of inflammation in the brain. And this inflammation is an important part of Alzheimer's, Parkinson's and ALS.

Dr. Max Boakye:

That is amazing. I think I would need to bring you back to talk specifically about all of that. That's just incredible, opening some new avenues of approach to the disease. Just briefly, how are you studying this? Are you using animal models or are you looking at the gut of humans and following them longitudinally? What kinds of approaches are you using?

Dr. Robert Friedland:

Yes. We have studied this in rats and mice, and in Japan, I worked with Drosophila fruit flies. And we're progressing with other studies here in Louisville, in collaboration with Dr. Bodduluri in microbiology and colleagues in the Cancer Center and the Department of Pharmacology to look at material from humans and germ-free mice that have features of Alzheimer's disease.

Dr. Max Boakye:

Where are you with these studies? Would you say you are very early in them, or are you fairly advanced to the point that there might be some potential therapies coming down pretty soon?

Dr. Robert Friedland:

There are many potential therapies that could be applied to the bacteria in the gut. And I think there is a potential in that regard that there may be treatments for brain diseases which involve medications or remedies that only act in the gut, that don't actually act in the brain, but by acting in the gut, they influence the health of the brain. And there is just a paper accepted in Nature Medicine this week from a company in Boston called Axial where they're delivering medication to the gut for the treatment of autism. So I think there is a lot of potential in that area. We're seeking funding and writing grants, and

it's very challenging because this is a new approach which is not part of the mainstream scientific endeavor to solve Alzheimer's disease or Parkinson's.

Dr. Max Boakye:

As I mentioned, I think I'll bring you back at a later podcast to really do a deep dive in this area, because I want to get to the aging and memory aspects. But just briefly for the audience, can you give an update on the mainstream thinking on Alzheimer's? First of all, how is Alzheimer's currently diagnosed?

Dr. Robert Friedland:

The best diagnosis depends on a comprehensive history, neurological examination, called a mental status exam, and an MRI scan. And if we do that, we can make a diagnosis with a certainty of 80 to 90%. We can do a bit higher in specificity and sensitivity if we also do a spinal tap or, in some cases, a amyloid PET scan. But the problem is, the disease develops in the brain 10 to 20 years before the patient has the first symptoms. So one third of people at 70 years of age already have an Alzheimer process developing in the brain.

Dr. Robert Friedland:

And we can measure that with spinal taps or brain imaging, however, that could be an indication that they will develop dementia from Alzheimer's if they live another 20 years. So many people will have this developing in the brain and then they will go on and get old and die without any cognitive impairment because the process develops so slowly, so that the most important thing about diagnosis is not distinguishing Alzheimer's from other causes of dementia, which are untreatable, like Parkinson's dementia, Lewy body disease or Pick's disease.

Dr. Robert Friedland:

The important thing is making sure there's no comorbidities or there's not a treatable cause. We published a patient who was 76 who came to see me. It appeared that he had Alzheimer's disease, everything supported that diagnosis, but he was taking Valium, 10 milligrams twice a day, for several years, and when he got off of that, he recovered. And that is the commonest cause of treatable dementia.

Dr. Max Boakye:

What is the hallmark of Alzheimer's memory changes that distinguishes this from other memory impairments?

Dr. Robert Friedland:

The main point there could be, forgetting is normal. We don't have enough room in the brain to remember everything, so forgetting is an active process, forgetting is desirable. You want to forget where you parked your car today; by tomorrow, you hope you forgot where you parked your car. So if I go to work and sometimes I'm looking for my car in the wrong place because I didn't forget where I parked yesterday. So the difference in Alzheimer's disease is the forgetting is interfering with social or occupational functioning.

Dr. Robert Friedland:

So if I forget who wrote Wuthering Heights, it's not important. But if I go to the grocery store and ask for where I can go borrow a book and they say, "Well, you're in the grocery store," and I say, "I want to borrow a book. I thought this was the library." Or if you go to the store in your car and then take a taxi home, because you forgot you drove your car to the store, these kind of more significant forms of memory loss.

Dr. Max Boakye:

Can you give a brief update on recent scientific breakthroughs in the treatments? So let's say you get a diagnosis of Alzheimer's, any recent breakthroughs as to how you might be treated now versus, let's say, 10 years ago or 20 years ago?

Dr. Robert Friedland:

Unfortunately, the answer to that question is no, there are no recent breakthroughs. And there, I must mention aducanumab is a monoclonal antibody developed by Biogen. The drug is called Aduhelm. And last year, I think it was June 7th, it was approved by the FDA, even though 10 members of the scientific advisory panel had reviewed it the previous year and recommended unanimously not to recommend it. The problem there is only that it doesn't work and it's dangerous and it's very expensive. So it was going to cost \$56,000 a year, but so many people were upset with that, Biogen lowered the cost by 50%, but it's still very expensive. 40% of people who took it in the clinical trials got sick or had brain edema or hemorrhages, which is not good. And the clinical improvement was rather small.

Dr. Robert Friedland:

And actually there were two studies. One of them was negative and one of them was positive. And as you know, you just don't get to choose. You don't say, "Oh, well, we'll pick the positive one, and the negative one, we'll ignore that." So this is not only my opinion. Medicare has reviewed this and decided that they won't pay for most patients. The VA also had some problem with it and the European agencies as well. So unfortunately, there is no disease modifying therapy. However, I recommend a whole series of things people can do to both lower their risk and possibly slow the progression of the disease.

Dr. Max Boakye:

What are some of those things?

Dr. Robert Friedland:

It's good to have a diet low in saturated fat, low in salt, low in sugar, high in diversity, and fruit and vegetables which are high in fiber. And it turns out Alzheimer's disease is less common in Africa and India than in North America and Europe. And the reason for that is probably because the diet in those two continents are richer in fiber and dietary diversity. So the best study there is in Nigeria, where they found people eat a lot of yams and sweet potatoes and they don't eat meat very often.

Dr. Robert Friedland:

And these issues in Africa, or anywhere, are very complicated, but just this is in general, people 50 years ago in Nigeria, they didn't eat a lot of meat and they have a God of yams. So yams are extraordinarily high in phytochemicals, phytoestrogens, plant estrogen-like compounds and fiber. And fiber is food for good bacteria that make short-chain fatty acids that help to control the immune system to enhance tolerance, which is good, which makes the immune system less active.

Dr. Robert Friedland:

And as I said, inflammation is part of Alzheimer's, Parkinson's, ALS, stroke, heart disease and cancer. So physical activity is also important. Physical activity produces growth factors in the brain, and everybody can use some of that, more neurons. Mental activity also is good for the brain. Head injuries are bad, but the interesting thing is that big head injuries are bad, little head injuries are bad, they're all bad. The human brain is not made to be smacked, and especially if it's smacked repetitively.

Dr. Robert Friedland:

So I saw recently that several members of some football team that won the Super Bowl a number of years ago, I forgot which team, but I think they won 17 games that year; the best season ever. And several members of that team have dementia from head injuries they received. It's called chronic traumatic encephalopathy and it's untreatable and a very bad disease.

Dr. Max Boakye:

That's very interesting. So let's talk about aging, because some of the same things that you mentioned relates to also the aging brain. But I want to clarify, is there a threshold, specifically for the Alzheimer's, is there a threshold of these things that are needed in order to reap the benefits? For example, how much exercise or physical activity? Is there a minimum threshold you have to meet in order to start seeing some benefits on preventing Alzheimer's?

Dr. Robert Friedland:

I don't know. I don't think there's enough evidence to say how much, but in general more is better. The principle I propose and I present to my patients is they need to do it consistently. So a lot of people think they're physically active because they like to go for a walk on a nice day. But we might not have a nice day for another week or two, or if it's raining, they won't go outside. So it should be something they do at least every day or every other day, not once a week or not twice a week.

Dr. Robert Friedland:

And it's not necessary to run. Many people think "I can't run anymore, so I can't exercise." But the important thing is to be moving. So walking is good, swimming, riding a bicycle, walking on a treadmill, on the elliptical machine or lifting weights is all very good. And similarly, if you have a steak for dinner on your plate, in addition to eating green peas, you may say, "Oh, I'm eating peas. Peas are high and fiber, and they're good for you." And that's true, but it would be better if the steak was replaced by something like eggplant or okra or cabbage, something that was actually good for you rather than just something which has no fiber whatsoever and has saturated fat, which is not good for you.

Dr. Max Boakye:

So we'll get into a little bit of the diet when we talk about the aging portion, not necessarily for the Alzheimer's, but optimizing your brain health during aging, because there are a number of different diets. One is the Mediterranean diet, which I believe cuts out meats, but has lots of vegetables. And maybe we can talk about the types of diets that would be helpful. But I want to switch into aging, and I know you are writing a book on aging. I just actually stumbled on it on Amazon, that it's coming out. And I wonder if you can talk a little bit about that, and that would give us a segue-way into talking about aging in general, aging in the brain. Your book is, I believe, titled How do we Unage? or something. You want to talk about that?

Dr. Robert Friedland:

Unaging: The Four Factors that Impact how you Age. Thank you, Max. So I believe many people have a unfortunately inaccurate view of aging. So the first idea is aging is not inevitable. If you assume aging is inevitable, you think, well, I might as well have a good time. I might as well eat burgers. I like hamburgers. I'm going to eat burgers, because I'm going to get old, I'm going to fall to pieces, everything bad's going to happen. When you get old, you get like this, you get like Uncle Fred and it's not good. But what people should understand is Princess Diana didn't get to be old.

Dr. Robert Friedland:

John Kennedy died when he was 47. So aging doesn't happen to everybody. And we all get one day older at a time, that's true. So we're all one day older today than we were yesterday. But we're not all one day older tomorrow than we are today because our survival is not guaranteed. I mean, this is true for all ages. And everybody knows people who died, who didn't get a chance to be 40 or 50 or 60. So rather than aging being inevitable, I believe it's an opportunity, because it matters what you do. So the other component of this is there should be three goals of aging, three goals.

Dr. Robert Friedland:

The first one is very obvious, which is not dying. We want to remain living. And we don't want to get sick, so we don't want to have diseases. Those two are obvious, everybody understands that. But people stop there. They say, "Oh, okay, here I am. I'm 65. Okay, I'm too heavy. I don't eat well. Maybe I smoke a bit, but I don't have cancer, I don't have heart disease, and so that's good." But they need to focus on the third factor, which is they should maximize their fitness because they need to have the highest possible resilience, or we all need the highest resilience so that when we get older and things do decline, we'll be able to survive challenges which develop.

Dr. Robert Friedland:

So as you know very well as a neurosurgeon, a 80-year old person may get pneumonia and die from that. But whether they die from that depends not only on the danger or disease mechanism of the bacteria in the lung, but also about their resilience, or their reserve capacity. Or maybe to put it in a neurosurgical context, many older people will fall and then they'll go in the hospital, they get pneumonia, and then they die. But the outcome of that scenario depends on their reserve capacity. So I have in my book, delineated that, and calling it multiple reserves. There's a cognitive reserve, a physical reserve, a psychological reserve, and a social reserve.

Dr. Robert Friedland:

And all of us can pay attention to these four reserves that we can enhance. So we enhance our cognitive reserve through mental activity, through a lifestyle filled with learning. And we can talk about what that could mean. And our physical reserve is enhanced by being physically active throughout life, but also having a good microbiota, so having our gut bacteria be framed or manipulated or managed through a good diet. Because when you eat something, if you eat a whole bag of pretzels, you're having high salt; salt enhances inflammation, salt enhances hypertension, salt is not good for heart disease.

Dr. Robert Friedland:

So when you're eating this bag of pretzels, there are negative effects on your bacteria as well as on your organs. And if you eat instead, let's say, some boiled sweet potato or lentils, you're having food that's

good for your liver, and it's good for your... The bacteria that eat these things are the bacteria you want, so you're changing the nature of your internal microbial populations. Similarly, if you develop good relations with other people, you're enhancing your psychological reserve, which is an important component of resilience, especially with aging, and also social contacts. So if you join a club or participate in a group or do things with other people, that's good for your health.

Dr. Max Boakye:

That is an incredibly valuable way to look at it. First of all, when is your book coming out? Is it out already or when is it coming out?

Dr. Robert Friedland:

It should be published in the United States in October.

Dr. Max Boakye:

Okay. Let me summarize again the four reserve that you need to build in order to build your resilience. One is cognitive. One is physical. A third is social. And the fourth one psychological. That is really an incredibly innovative way to look at it, and I predict this is going to be really helpful to a lot of people. You mentioned the cognitive, let's kind of focus on the cognitive. You said learning. Does that include playing brain games, music, things like that?

Dr. Robert Friedland:

Yeah. So nobody knows if anything is more valuable than other things. It's not like crossword puzzles are better than chess. I think what's important is learning is the work of the brain. Of course, the brain does many, many things, but when you're learning, you're actively using the brain, you're changing the brain structure. But there are games that don't involve learning like solitaire. You do this, and you do this, and you could do this your whole life.

Dr. Robert Friedland:

And your brain is not activated by playing a game by yourself. If you watch Seinfeld reruns on television, you may already know the jokes that's coming. You know what they're going to do. You're not learning anything. Your brain is not engaged in that. Because after all, if you were watching television and you died, that TV would just keep going. If you're reading a book and you fall asleep, the pages do not continue to turn. So then if you want to go back and discuss, think about, well, what are they?

Dr. Robert Friedland:

You can do that in reading a book, you can't do that when you're watching television. So I think learning is the key factor. And the other component I failed to mention about the third goal is that the declines with aging don't happen to everybody. Aging is not inevitable in that the declines with aging are not inevitable. So it's true that every 80-year old will be weaker when they're 80 than they were when they were 30. That's probably true. But it's possible for a 60-year old who smokes and is too heavy, eats badly and doesn't exercise, if this 60-year old would stop smoking, lose weight, eat better and exercise, when he's 70, his heart and his brain could be in better shape than when he was 60.

Dr. Robert Friedland:

So the decline is for a population, but many individuals do very well, can stay the same, or actually improve. It depends on what they do. And the only thing about aging which increases rather than declines is variability, which means 30-year old people are more like other 30-year old people, than 70-year old people are not so much like other 70-year old people, because some people, when they get to be 70, have a lot of declines, and some people when they get to be 70 are perfectly fine and have not declined. I mean, not declined maybe in their cognitive capacity or their muscle strength or their cardiac output or pulmonary function. There is a decline in a population, in a group of people, but individually, some people can do very well. So it's not inevitable. It matters what we do.

Dr. Max Boakye:

For a specific individual, doing those things you mentioned can optimize you and build your resilience. And so 10 years later, you'd be much better off than if you weren't doing the those things.

Dr. Robert Friedland:

That's right, exactly. Yes. Many older people fall and break their hip. And as many as 20% of older people who fall, break their hip, go to the hospital, about 20% of them people will die, because they can get pneumonia in the hospital and then that can be enough. But whether that will happen depends on their resilience, so it depends on their reserve capacities. Of course, you want to avoid the fall and you want to avoid the fracture and you want to avoid getting pneumonia when you go to the hospital, but you have to understand that those are things that happen to people, and you want to be able to handle the stress, the psychological and physical, organic stress involved so that you can survive.

Dr. Max Boakye:

Going back to your book, you titled it Unaging. First of all, let me ask, what made you write this book? And also what drove you to study memory in general, to really work in this area?

Dr. Robert Friedland:

Well, thank you. When I started in the 1970s, there was very little interest in Alzheimer's disease and there was very little known about it. And for some reason, I'm drawn to challenges or to difficult topics. So I know this is wrong, it's just my view, that why would I want to be an obstetrician? You don't really need a doctor to deliver babies. A wet nurse can do that. So it's not a difficult problem, it's not a challenge. And I know that this is wrong, there are difficult pregnancies and I'm not criticizing obstetricians.

Dr. Robert Friedland:

It's just that it wasn't interesting to me to want to do something like that. And then neurology involves the study of the brain, which is the most complicated thing in the universe. It's responsible for everything about humans that is interesting. Our musculature is not that impressive compared to gorillas or chimpanzees or lions, but it's the cortex. And the cortex is the most fun part of the nervous system. And I could say my grandfather had dementia, but this happened when I was really too young to understand what was going on.

Dr. Robert Friedland:

And this is a remarkable area of medicine because we can really engage with our subjective interest directly. So if I want to know how a patient's brain is working, I can find out by talking to them. If I'm a

urologist and I want to know how the kidneys are working, I can't possibly do that if I can't do a blood or urine test. And there's an interesting aspect of this. Did I see that you went to Cornell University?

Dr. Max Boakye:

Yes. Yes, I did.

Dr. Robert Friedland:

Did you know Fred Plum?

Dr. Max Boakye:

Yes. Everybody knows Dr. Plum. He wrote a book, Diagnosis of Stupor and Coma with Jerome Posner.

Dr. Robert Friedland:

Right. So Fred Plum was the president of the American Neurological Association and a chairman at Cornell University in New York, medical school. And he was very dominant. And he didn't have any interest in Alzheimer's disease. I don't know why, but the whole idea about cognition and mental function was not interesting to these people, not only Plum, but other leading people in neurology. So in his department, he'd have a specialist in epilepsy, a specialist in nerve and muscle diseases, a specialist in MS, but not a specialist in Alzheimer's because it wasn't interesting to him.

Dr. Robert Friedland:

And then he went on and died of Alzheimer's disease. And I mean, this is not confidential, it's published in the journal, in his obituary, or in some features of Alzheimer's disease. And it just shows how important this disease is and how it hasn't gotten the proper recognition. The problem here is that it's not a good way to make money because all we do is talk to people. We don't do laminectomies. You can make more money doing a laminectomy in half an hour than I would make in two weeks. At the same time, Alzheimer's is one of the most common neurological conditions anywhere. It affects up to 30% of the population at 70 years of age.

Dr. Max Boakye:

In our last few minutes, and I'm going to have to bring you back, because I have many more questions, I want to know what is the most surprising thing you've learned about the brain, studying the brain and memory? What has surprised you the most? And then if you had a magic wand, what kind of questions would you try to answer with that? What would you do with it in your study of memory and aging?

Dr. Robert Friedland:

Right. Thank you very much. It turns out that microglia are involved in learning and memory. Microglia are immune cells that are present in the brain that are the macrophages of the brain. Just like we have white blood cells, monocytes, macrophages, and leukocytes all over the body that have immune functions. They destroy invading organisms and rebuild tissue. And in the brain, it's the microglia. And I thought the microglia were responsible for cleaning things up and killing viruses and bacteria if they happen to enter the brain.

Dr. Robert Friedland:

But the recent evidence is that microglia actually mold or sculpt synapses. And when we're learning something, our microglia are active in helping establish these connections, as well as if we forget something, connections will be lost. And that's good. That's normal. The destruction of unwanted neurons and connections is done by microglia. And the surprising thing, which only is one or two years old, is researchers from Germany have shown the microglia function and structure is influenced by gut bacteria.

Dr. Robert Friedland:

So the bacteria are actually influencing the processes in the brain of learning and memory. And that if you have a 16-ounce steak for dinner with a lot of salt, the fat and the meat itself is not supporting healthy populations of bacteria in the gut. And if, on the other hand, you eat brown rice, whole wheat bread and beans and nuts and fruit you are helping to build that healthy bacteria, and that these bacterial populations can help with learning and memory through influences on the microglia.

Dr. Robert Friedland:

And if I had to wish for what I would like, I would like to have an astronomical approach to disease, so that if NASA is exploring some foreign body eight billion miles away with some probe, they're going to want to see everything they can possibly see about it. But humans are still largely unexplored. So I'd like to know what microbes are present in the sphenoid sinus in the center of the brain; well, right below the center of the brain. How about the maxillary sinuses here, which are commonly filled with fluid or having a cyst or membrane? And we don't know. Otolaryngologists, they're not interested in this.

Dr. Robert Friedland:

How about the bacteria in the skin? How do they influence the brain? We don't know. Nobody has looked at that. So that there are many things about the body which we haven't explored because we've been too focused on our own ideas, and we don't have a properly wide imagination. And we don't appreciate the wisdom of Paul Feyerabend, who was a philosopher of science at Berkeley, who said, the only principle of science that works is "anything goes." So we need to approach the body with an open mind and look at where these interactions can take place.

Dr. Max Boakye:

All right, Dr. Friedland has to leave in one minute, but we want to thank him for what have been a truly amazing conversation. I promise you, I'm going to bring him back for part two of this and possibly part three, because there's so many points that we can expand on along many lines: the microbiota, the deep dive into the research that he's doing with that, and the whole concept of aging. For example, I wanted to get into, are there physical changes in the brain when you start building the cognitive resilience? Are there physical changes that happen in the brain?

Dr. Max Boakye:

If you already have bad changes in the brain, can you reverse them? There's many questions that I would like to bring him back to talk about. But in the meantime, we'll put links to his papers and hopefully when his book comes out, make sure you buy it for more information. Dr. Friedland, thank you so much for coming on.

Dr. Robert Friedland:

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Thank you very much, Max. Thank you.

Speaker 1:

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