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John Moe: You know when you say, “I heard this thing on a podcast the other day,” and then you go on to tell someone all about this fascinating or disturbing or surprising story or interview you heard? Well, yeah, that's about to happen here. The other day is today, right now. And the thing you heard about has to do with lead and its effect on mental health and cognitive ability. The thing you heard is likely to stay with you for a while. Like lead, actually.

And the podcast? The name of the podcast? It's *Depresh Mode*. I'm John Moe. I'm glad you're here.

Transition: Spirited acoustic guitar.

John Moe: I'm glad you're here, and I kind of hope you're sitting down, because this is some heavy stuff. There's a very good chance you are affected and perhaps impaired by lead, according to new research. Lead from car fuel, a new study says, is responsible for 151 million instances of psychological disorders between 1940 and 2015.

The group affected the most? Generation X: babies born between the mid to late '60s and the early '80s. That's when lead was in use the most, and so the brains of kids born then were most affected by it. Lead was first introduced to gas in the US in 1923 and stuck around until 1996. In other words, we were all poisoned. And those of us Gen Xers—hi, I'm one of them—we were poisoned more than anyone. And it had an impact on our rate of mental illness and on our IQ as well, which is not great.

Dr. Aaron Reuben is coauthor of the study, published in the *Journal of Child Psychology and Psychiatry*. He is a post-doctoral scholar in neuropsychology at Duke and the Medical University of South Carolina.

Transition: Spirited acoustic guitar.

John Moe: Dr. Aaron Reuben, welcome to *Depresh Mode*.

Aaron Reuben: Thanks for having me. It's nice to be here.

John Moe: What is the top-line finding in the research that you conducted?

Aaron Reuben: So, our research took two stages.

Stage one: we have known for many years that putting lead into gasoline was disastrous and reliably led to high lead exposures for folks born during the era of leaded gasoline. But we have not until now had a good sense of what people's level of exposure would have been when they were kids. So, stage one for our study, we used published, publicly available information about the amount of lead we consumed in gasoline. And we matched that with

information about blood lead levels in the US population from the years when we started doing surveillance testing.

And using that, we were able to reverse engineer and estimate, for Americans alive today, what their level of lead exposure would have been when they were kids, going back to folks born in the '40s, '50s, and '60s. We then took those estimates—which, by the way, identified that a vast number of Americans alive today, had high lead exposures as children; levels that were two/three/four times higher than what today would trigger clinical attention and case management.

We took that information about how high lead exposures were in the past, and we matched that to published lead harm curves on what sort of consequences you see in people exposed to lead, in terms of brain health.

Initially, we looked at IQ and determined that the US population lost around 800 million IQ points as a result of exposure to lead from leaded gasoline. And then in our newest study today, we did the opposite. Instead of looking at IQ points lost, we looked at what we call mental illness points gained. So, using scales similar to IQ points but now taking into account someone's mental overall liability to having mental health problems, more symptoms, more severe symptoms, more comorbidity.

It's hard to know what a mental illness symptom point is, but the general gist is you want as few as you can have, and having more is worse. And what we estimate is that the US population gained 600 million mental illness symptom points as a result of our use of lead in gasoline. And that equates to an additional around 151 million cases of psychological disorder that the US population experienced that it wouldn't have if we hadn't put lead into gasoline.

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John Moe: Spanning what years? What years are covered here?

Aaron Reuben: Yeah. Great question. So, we started putting lead in—America, by the way, is the country that did it first. We started putting lead into gasoline in the '20s. So, it first started in 1923, and it slowly ramped up. It ramped up even more through World War II. And then it really hit its peak in the mid-'70s.

For reasons of data availability, our study today only looks at the years 1940 to the present. So, folks born in the '40s, what were their exposures? '50s, '60s, and onward.

John Moe: Okay. Okay. And then within those years, there was a kind of a hotspot era, spanning like 4 years or 12 years? What was the deal with people—the unfortunate Generation Xers? They seem to have gotten it worse.

Aaron Reuben: Yeah. (*Sighs.*) Yeah. So, there was an interesting phenomenon with lead in gasoline, which is we slowly put more lead into gasoline. And of course, we put more and more cars on the road spewing and aerosolizing that gasoline out into our communities and

atmosphere. The amount of lead in gasoline being consumed went up and up until 1975 when we started the phase out.

You know, and incidentally, we didn't start the phase out right away to protect public health. We did it because lead poisons catalytic converters, and we mandated that new cars that came on the road in 1975 would have to have catalytic converters in order to fight acid rain—which is a problem, thankfully, we've mainly solved.

So, lead exposures were—we think of peaking in the '70s around '75 and then going down. Well, that means the lead harms for mental health also peaked in '75. And so, we tend to think of folks born in the mid to late '60s, across the '70s, and then early '80s as being the peak lead exposed generation. And so, if you scratch your memory banks, you'll think, okay, that's about Generation X.

I've started referring to Generation X as Generation Lead. Because (*chuckles softly*) if you look across human history, there's definitely been populations and individuals exposed to high levels of lead. It was not uncommon for a large number of people to actually die from their lead exposures over the last, let's say, 2000 years.

But really, those exposures were isolated based on, you know, what home you lived in, what job you had. And that was all true until we put lead in gasoline. And so, I call Generation X peak lead generation, because they—as far as I can tell—are the first generation in human history to have been indiscriminately exposed to lead at a mass scale. I call it the largest contaminant experiment we've ever conducted.

John Moe: Mm. Well, I'm a lab rat in that experiment, Dr. Reuben.

(*They chuckle and Aaron affirms.*)

What does this mean in terms of mental health for people born in that target range, people who are part of Generation Lead?

Aaron Reuben: So, what we know from, I would say at least 20 years of observation—in one of the studies that I work on, we've actually been observing kids exposed to lead not in specific settings, but just in everyday life. We've been following them for almost 50 years now. And what we see again and again whenever we look is that, particularly when the exposure happens when you're young, lead disrupts brain development in a way that is pro-degenerative and pro-mental illness.

So, we're not entirely sure why. We know on a mechanistic cellular level what happens when lead gets into the brain. It's interesting; we can talk about it. You know, one of the most direct impacts is your neurons use calcium for a lot of their important processes, like neuronal signaling. And in the brain, a lead ion looks a lot like calcium. They both have a 2+ charge. So, neurons will take up lead instead of calcium, but they won't be able to do what they set out to do. Because lead doesn't actually have the same properties as calcium.

John Moe: It's empty calories. It's junk food.

Aaron Reuben: (*Laughs.*) Yeah. You know, I think it's a little worse than junk food. 'Cause—

John Moe: It's lead!

Aaron Reuben: Yeah, exactly. It's actually taking neurons offline. It's going to result in neuronal death, disrupted proliferation, disrupted signaling. One of my favorite descriptions is lead gets into the wiring, and it cuts the wires, but it also pulls the plugs and changes the wires around.

So, what we see is what you might call like a disordered brain, or a less well-organized brain.

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So, what does that look like? Early on, you know, into adolescence, we see greater rates of executive function deficits that look a lot like attention deficit disorder. Impulse control problems, problems staying on task, problems paying attention, moving through the world in a way that is going to help you achieve your goals. All of that is going to be a little harder. And we see greater risk of actually getting a diagnosis of things like Attention Deficit Hyperactivity Disorder as you go up the lead exposure chain.

We call it a dose response curve, but it actually is more like a hill where your earliest bits of exposure seem to do the most harm, and then additional exposures cause more harm. You sort of move higher up the hill. But there's a deceleration there. So, we see greater risk for attention deficits, greater risk for conduct disorder problems, antisocial behaviors, greater risk for psychosis and schizophrenia.

And then in the studies that I work on, where we follow large groups of people, and we look at a kind of a vast array of mental health problems you could have, and we take a step back and look in a broad way, we actually see elevated problems across pretty much every diagnostic category of a disorder you could have. So, we say this increases your liability to general psychopathology.

John Moe: Okay. Are the brains and bodies of babies just that much more susceptible to lead than an adult living through the same exposure?

Aaron Reuben: Yeah, it's an interesting question, because we focused a lot of our attentions on protecting children. Which I think is absolutely critical. But we often ignore the adults then. So, the action levels for lead in blood in an adult are almost 10 times higher for the ones in children. And I don't think those adults are actually invulnerable to that lead. It's just that they've moved past critical windows where the lead can do the most harm.

So, once your brain networks are formed, obviously there's plasticity; things come online and offline. But they're just—they're not quite as liable to be pushed off the rails as a developing brain. We also know that kids are more vulnerable to lead just by nature of their bodies. They are closer to the ground, where lead soil and dust tend to accumulate. They put their hands in their mouth more often. It appears like they're internal mechanisms for detoxification are less

robust. Their blood-brain barriers, which can help protect the brain from other assaults, are less robust.

So, there's a lot of reasons we think kids are vulnerable. But to me as a neuropsychologist, I think the primary thing I'm concerned about is that their brain is still developing. And there's a lot of critical milestones that lead can get in and disrupt in a way it doesn't seem to for adults.

That said, we do see what I think is a second window of vulnerability, which is in the second half of our lifespan as we're getting older. We see in older adults exposed to lead, folks in their '60s and '70s, faster rates of things that we're extremely worried about—like cognitive decline, things on the pathway to dementia.

John Moe: There's still lead out there. Are we still all being negatively affected by it?

Aaron Reuben: There is still lead out there. It is a whole lot better than it was in the '60s, '70s, '80s, and '90s, you know. And it depends where you live.

John Moe: That's like being told you're not as on fire as you used to be.

Aaron Reuben: 100%! Absolutely. You know, you might think of it like a low-grade fever or like endemic malaria. We're all still a little sick. We're not as sick as we used to be.

It's interesting; we were the first to put lead in gasoline, and we kind of taught the rest of the world how to do it and why. We were also one of the first to take it out. If you look at the UK—so, we finished phasing lead out of gasoline by 1996. The UK didn't until 2000. The last country to stop using lead and gasoline on road vehicles, that happened in 2021. That was in Algeria.

So, depending on where you live, the legacy of these past exposures can be a lot more potent than it necessarily is in the US. That said, lead is interesting. It is the heaviest, most stable element in the universe. And so, once it's put out there, it's not going anywhere.

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Unless you remove it, cap it, dilute it, it's right there. So, if you look in the soil along roadways in every major city in the country, you're gonna find lead. And you're going to find hot spots of lead in places like the bottom of a hill, where trucks would have had to brake and then gun the engine, and they would spew more particles out.

In Durham, North Carolina, where I lived most recently, we used to incinerate our domestic household waste. Many, many cities did this up until the '60s, probably half the cities in the country. All that waste was heavily lead contaminated, and those former waste incineration sites—which were located in neighborhoods, because it was easy to just pull the trash down the street and burn it—a lot of those incidentally are parks now.

If you go into those parks and test the soil, a lot of them have really high lead levels. And that's something we know about Durham, because there are soil scientists at Duke University. Most cities will have the exact same history and hotspot of exposures, but no soil scientists. So, you don't know what's happening.

Transition: Spirited acoustic guitar.

John Moe: Back with more from Dr. Aaron Reuben in a moment.

Promo:

John Moe: Hey, have you ever wanted to make your own podcast? I know you enjoy the podcast that we make, but have you ever wanted to make your own? Well, good news. I'm teaching a one-day online class on February 1st, 2025, called *How to Write Your Podcast*. It's a writing class where you'll learn from me how to develop an idea, find your story, write it, and speak it.

It's being done through the Loft Literary Center, but it is online, so you can take it wherever you are. But space is limited. Go to LoftLiterary.org and search up my name for more details.

Transition: Gentle acoustic guitar.

John Moe: We're back with Dr. Aaron Reuben.

Why was all this lead put in gas tanks and in paint and in pipes in the first place?

Aaron Reuben: It's a great question. I'm asking myself this all the time. It was put in pipes. It was put in paint. It was put in fuel. It was put in—

John Moe: Windowsills.

Aaron Reuben: Solder, electrical connections, windowsills, gaskets. The list goes—oh, cookware, pottery, glazings. The list goes on and on. Why did we do it? As far as I can tell—and again, I'm a psychologist; I'm not a material chemist or scientist. But I've done a lot of reading, because I'm working on a book about this. And as far as I can tell, lead just has some really unique properties that make it very tempting to use.

One of those properties is it's pretty abundant. It's available in large loads in surface crusts in a lot of countries, particularly in Europe and America and Australia and China. So, it's easy to get to. It is not fancy. You know, unlike gold and silver, there's kind of nothing that draws the eye to it. So, it's easy to apply it in a lot of settings. In that—for that reason, it's often cheap. And it is, as metals go—and metals are great, because you can do a lot of things with them that you can't with other materials. As metals go, it is one of the easiest to work with. It's really malleable; it's soft, but it's hard and heavy at the same time. Its melting point is really low. So, you can smelt lead in a campfire. Not true for things like copper or iron or gold.

So, if you look across human history, it was abundant. You could get to it. People didn't want it for fancy uses, so it was cheap. And it was really easy to work with. So, that's why empires like Rome really loved it. I mean, they used it for all kinds of things. And it played a large role in their society's fast movement through technological advancement. You know, having indoor plumbing, having gorgeous fountains and baths and saunas.

They used tons and tons and tons of it in their water supply. They also used it in their currency systems. For other reasons, they ended up consuming a lot of it, which we could talk about. But lead just has—you know, a short answer to your question is lead has some magical properties that make it really tempting to use.

John Moe: I can understand a lot of those things, but what about gas? What does it contribute to gasoline?

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Aaron Reuben: Yeah, my understanding is lead—it's an anti-knock agent, so it improves fuel efficiency and improves engine performance. As far as I understand. And I always love it when people give me feedback when I get something wrong. Because as a psychologist, I'm often moving into spaces I don't fully understand. But from what I gather, it helps fuel combust when and where you want it to, in the pistons of your engine, and not where you don't.

And so, that's one reason it's still in fuel for a lot of combustion engines. So, it is still in aviation gas for small piston aircraft; it's still in some maritime fuels; it's still used in farm and off-road equipment. Racecars and motorbikes still use lead. It's wild to me, but we're still combusting it and spreading it into the atmosphere, across our communities.

John Moe: So, people of Generation Lead are more likely to have amassed some of these mental health points, these mental illness points that you talked about. How can we be sure that it's lead exposure that is specifically responsible for mental health issues, rather than other factors like low income or lack of investment in health care, which could also contribute to poor mental health? These things that might also be present in areas with high lead.

Aaron Reuben: Yes, this is a critical point. And you of all people know that mental health problems are what we call multifactorial. There's so many things that are going to determine how you think, feel, and behave at any given moment of your day. Some of the most robust—you might call risk factors are well-characterized and what I'd say non-modifiable. Like your genetic propensity to mental disorder, or your childhood experience of abuse, neglect, maltreatment. All of those things are going to play a role in whether you grew up to be an adult who suffers from a psychological illness.

For our studies—so, for the study today where we estimate the population mental health burden of lead, we are reliant on previously published—what we call lead harm curves. And those arrive from cohort studies where we have followed people over time, and we try to take into account all of the other factors that are not just going to contribute to mental health problems, but that interact together, so that they all kind of add up. You can think of it as a

glass of water. You pour in a little water. That's your genetic loading. You pour in a little more water. That's your history of childhood stressors. You pour in a little water. That's lead. At some point, the cup's gonna overflow.

We rely on almost exclusively on cohort studies to understand these effects, because it's not ethical to randomize kids to receive different levels of lead exposure. We're a little hamstrung. With a medication, you'd run a randomized controlled trial. You'd give some people the drug, and some people you'd withhold the drug. You'd study them, and you'd say, "Alright, this is a causal effect of the drug."

In this case, we look for places where there's either natural experiments, where some people who were similar didn't get an exposure to others who did. Or we look for places, like the cohorts I work with, where exposures were sort of haphazard and uniform. So, one of the primary studies we drew on for our estimates comes from a longitudinal cohort that has been following everyone born in one city in New Zealand since their birth in 1972. And this is a globally unique birth cohort for studying lead, because the extent of lead exposure was not confounded by social class.

So, we saw that kids from very well-to-do families had high exposures. Kids from poor families had high exposures. And then kids across the spectrum had high and low exposures. And it means we're able to disentangle the influence of lead from correlated disadvantages like poverty. So, if you try to study lead in the US, you're a little more hamstrung.

Because we know, in the US at least, the extent to which you were exposed to lead as a kid is entwined with where you lived, whether you were in a poor community, an urban community. We know that Black children in the '80s and '70s, their lead levels were often 20% higher than White children. They also went on to experience other disadvantages that might contribute to mental health problems.

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So, we look for these settings like in New Zealand, where you're just—by the design of your study, you have a little more power to look at cause and effect. And in that study in particular, we were able to take into account things like maltreatment in childhood, family history of mental illness, family socioeconomic status, lots of things that we try to adjust for in our models.

Transition: Spirited acoustic guitar.

John Moe: More with Dr. Aaron Reuben about lead and brains in a moment.

Promo:

Music: Playful rock music.

Dave Holmes: Oh my gosh, hi! It's me, Dave Holmes, host of *Troubled Waters*—the pop culture battle to the ego death. Okay, everybody. Word association with *Troubled Waters*. First one to fumble loses. Go.

Riley: Comedy.

John-Luke: Panel show.

Christian: Guests.

Riley: Celebrities.

John-Luke: Games.

Dave: Oh, sound rounds!

Riley: Improvised speeches.

John-Luke: Puns disguised as trivia.

Christian: A very niche *Flash Gordon* clip.

Riley: Umm, Chappel Rowan!

Dave: Oh no, Riley, I'm sorry; she will not return our phone calls. I am afraid you're out.

(Failure buzzer.)

Riley: A girl can dream.

Dave Holmes: Oh, but dreaming will not earn a girl any points.

Troubled Waters! Listen on Maximum Fun or wherever you get your podcasts.

Promo:

Music: Fast-paced synth.

Yucky Jessica: *(Rachel McElroy doing a rasping, whiny voice.)* I am Yucky Jessica.

Chuck Crudsworth: (*Griffin McElroy doing a gravelly, nasal voice.*) I'm Chuck Crudsworth.

Yucky Jessica: And this is—

Jessica & Chuck: *Terrible!*

Chuck Crudsworth: A podcast where we talk about things we hate that are awful!

Yucky Jessica: Today, we're discussing *Wonderful!*, a podcast on the Maximum Fun network?

Chuck Crudsworth: Hosts Rachel and Griffin McElroy, a real-life married couple—

Yucky Jessica: Yuuuck!

Chuck Crudsworth: —discuss a wide range of topics: music, video games, poetry, snacks!

Yucky Jessica: But I hate all that stuff!

Chuck Crudsworth: I know you do, Yucky Jessica!

Yucky Jessica: It comes out every Wednesday, the worst day of the week, wherever you download your podcasts.

Chuck Crudsworth: For our next topic, we're talking Fiona, the baby hippo from the Cincinnati Zoo.

(Music ends.)

Yucky Jessica: I hate this little hippo!

Transition: Gentle acoustic guitar.

John Moe: Back with Dr. Aaron Reuben talking about lead. What inspired you and your team to do this research in the first place?

Aaron Reuben: For me, it did start with this New Zealand study. I joined an epidemiology lab, and I did not set out to study lead. I thought I'd be looking at, you know, the new exposures of the day, microplastics, PFAS, looking at epigenetics. And we definitely worked on those things.

But early on, a dentist affiliated with our study who was trying to do some new work on fluoride—so, you may or may not know, but fluoride is emerging as a new chemical, a new additive of concern that may have some neurotoxicant properties that we haven't fully anticipated, so we're doing new work on that.

But this dentist had unearthed our studies archives, had been going through them looking for fluoride, and he found this old lead data. And he wrote to us, and he said, “Hey, is lead interesting to anyone over there in the States? Like, would you like to use this data?”

And my advisor at the time came to me and said, “Hey, we've got this lead data. Is this interesting?”

And my first response was, “No. Why would this be interesting? Haven't we learned everything we need to know about lead?” Right? But I said, “Let me stop and look at the literature.”

And I looked, and I discovered two things. First, I discovered that the people who had been exposed to the highest levels of lead, they're not long dead and buried. They're not 100 years old. They are alive today, walking around, and they're in their 40s and 50s and 30s. That was a real aha moment. And then the second thing I learned was that we started most of our studies about lead harms in the '80s and the '90s. And by the 2000s, we had sort of published all our findings, and we said, “Alright, let's move on.”

But we hadn't really followed up to see what happens to someone who's been exposed to lead as a child throughout their whole life as they get older, as they enter the job market, as they go through divorce, as they get ready for retirement. There's just so many points in the lifespan where we have the opportunity to be pushed off our trajectory. And those had never been evaluated. We truly had really mainly focused on kids and young adults.

And so, I said, “Let's start doing more studies where we follow that peak lead generation and see how they're doing.” When I did that, I started to see, gosh, there are a lot more consequences than we knew about. They are worse than we knew about, and they appear to be getting worse.

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And so, that made me concerned about this whole population of people with a history of lead exposure that is essentially invisible to them or us. And I mean invisible not just to them and their doctors, but to us as a society as we ask ourselves where have we come from and where are we going?

So, with those two sort of insights, I've embarked, and I've pulled in along the way other colleagues and collaborators—some who've been working on this longer than me, some who are newly into the topic. And together we're trying to sort of unearth this legacy. And that's why we did the study today.

John Moe: Question, or a couple of questions for you that I got a feeling you won't be able to answer as specifically as I'd like, but I have to ask them anyway. As a member of Generation Lead, how much more mentally ill am I, and how much lower is my IQ than if I had never run across this stuff in the first place?

Aaron Reuben: Yeah, it's a good question. And it's the generation of concern, right? I would need to dig up some of the exact numbers, but let's say you were born in 1970. And here I'm actually gonna look at the numbers that we reported, 'cause I think we pulled out specific estimates for folks from that time period.

And here's where the numbers might get a little unsatisfying—not because they're imprecise, but because it's hard to wrap your mind around these things. So, I'm going to talk about standard deviations. And what is a standard deviation? I want everyone listening to imagine a bell curve, because that's the distribution that problems tend to take.

So, most people are in the middle; they have some problems. Some people are on the tails. At the high end, they have a lot of problems. Numerous symptoms, numerous diagnoses. They're going to require hospitalization and treatment off and on throughout their lives. On the other end of the curve—you know, the little tail—are people who are probably never going to go on to meet criteria for a disorder. They're going to have symptoms. We all have symptoms. We all have intrusive thoughts. Some of us can ignore them or refute them more readily. I'll have ten in an hour.

Those of us who go on to require treatment or benefit from treatment, we just have enough symptoms that we kind of meet criteria. If you are from this peak lead exposed generation, our evidence suggests that we have shifted the curve for your whole population an order of magnitude almost. So, nearly two standard deviations. So, a standard deviation is just when you get a bunch of people in a room and you see how many symptoms they have, how different are they person-to-person?

When we shift the standard, the sort of mean symptoms, up by almost two standard deviations, we're going to increase the number of people in that high/severe mental illness range by 10/15/20%, and we're decreasing the number of people who never have a problem.

And so, for you, I can't say one-to-one how many of your problems are attributable to lead. Unless! And this is important—unless you had your blood lead tested. In which case, I can go to our curves and say, okay, for the average person from your generation, we think you've probably lost four to six IQ points on average, based on your lead exposure. And I would say you've probably gained two to three mental illness symptom points.

And this is where it's hard to know what the consequences are, because I need to know what's your genetic propensity to mental illness. How stressful has your life been? Things like that.

John Moe: I'm glad I'm just right in the pocket where I can understand all that.

(They laugh.)

I haven't lost quite enough that it eluded me. I still was able to hold on. Did these results surprise you?

Aaron Reuben: I know what we're looking for, because I start with the knowledge that we conducted the largest mass contamination experiment in history. I'm always surprised at how large the numbers come back. It's one thing to know that you will—you know, if, you're exposed to a certain amount of lead—it's one thing to know that if your blood lead level is 10, then you've probably lost three IQ points relative to what you would have had.

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It's another thing to apply that to the whole population and see, oh my gosh, 800 million IQ points lost. The number of geniuses who didn't come to be. The number of people who have lifelong cognitive impairment, so that they couldn't finish school or get meaningful employment, are on the order of millions. The numbers always stagger me.

John Moe: What is the response been to this study now that it's out in the world?

Aaron Reuben: We've gotten a lot of interest from media outlets, people picking up the story and saying, "Whoa! That's astounding that something we put into the air could have changed the way our whole country thinks, feels, and behaves." No one has—it's interesting. With lead, it must be that there's just been so much evidence over so many years that we all kind of get it, that it's bad. And now it's really just a question of figuring out how bad, when and where, for whom, what on earth can we do about it?

But we have not had any pushback. I have not had any controversies. You know, it's interesting. There's other environmental pollutants and challenges that really seem to follow political lines. Lead cuts across red and blue, Republican, Democrat. Everyone kind of gets it. And I think we need to do more to remove the lead exposures we have in our homes, and we definitely need to stop putting lead into products that are like fuel sources and spreading it throughout our communities.

But it doesn't seem to be controversial at the moment. It's more a question of how much resource are we willing to marshal to address the problem.

John Moe: Should we be freaking out, those of us in Generation Lead, because we got poisoned?

Aaron Reuben: You know, this is—it's an interesting story, because this is one thing that we got really, really wrong, but then we got right. You know, we—I will not say we've solved the problem by any means, but we've been—every year we make progress.

But. For those of us like yourself, like me, who were exposed to levels of lead when we were children that today would cause clinical concern and would send a state health inspector to your home, what do we do about it?

One thing that I'm working on—so, there's a lot of elements to this. One is that we believe a significant portion of that lead is still in your body. So, about 90% of the lead you've been exposed to as a kid—it's a little lower, but as you get older, more and more of that lead gets locked up in your bones. And some people tell me that's on purpose, and the bones are doing it to sort of protect the rest of the body. I'm skeptical of that. I think it's probably a biochemical accident, again, because lead looks—a lead ion in the body looks like a calcium ion. But for whatever reason your skeleton is a long-term bank for lead.

We can use that to try to figure out how much you've been exposed to and what consequences you might need to be on guard for overtime. But we also want to make sure the lead stays there. So, when there are events that remobilize elements from the bone—bone breaks, pregnancy, menopause, osteoporosis, calcium deficiency events, malnutrition—there's evidence that's going to remobilize the lead and recirculate it into the body where it's going to be taken up by other compartments where it's a lot more harmful. Like the brain, the heart, the kidneys, the liver.

So, for me moving forward, one question is: can we scale up and deploy more schemes to let people know how much lead is in their bones? And we can talk about what those might look like. And then number two, can we make sure that folks who do have high levels of lead in their bones are aware of it and are pursuing strategies that might plausibly keep it there?

So, we don't have a lot of studies on this, but the evidence that I've seen suggests things like calcium supplementation can help keep lead from being remobilized. I have a hypothesis that things that keep your bones healthy, like heavyweight resistance training, should keep that lead stored in the bone.

[00:40:00]

But again, there's just has not been a lot of follow up study in kids who are exposed to lead, how they end up looking as 40-year-olds, as 50-year-olds. And so, that's some of the work we're doing now, again with our New Zealand cohort, but others around the world as well.

And then finally, if you think that you were exposed to high levels of lead, because you were born in 1970, and because you grew up on a busy road, or in a dense urban setting, or you know that there was a trash burning facility nearby or a lead smelter or a battery plant—I mean, there's so many industries that we're using and emitting lead. It's not just the tailpipe of cars.

But if you know that you were in one of these high-risk zones, I would encourage you today to consider yourself as high risk for the ailments that we know are related to lead. So, mental health problems are one, but cardiovascular disease is another. Lead is a known causal contributor to cardiovascular disease. We know that lead elevates risk for cognitive decline, and we're now evaluating does it precipitate Alzheimer's type Dementia specifically, or does it just wear out your brain? Either way, if you think you've been exposed, I would like you to go ahead and consider yourself at high risk for aging poorly and use that as motivation to pursue some of the strategies that may help you age better.

And we know what these are. Good diets, adequate sleep, lots of exercise. I don't know if those things will be uniquely beneficial to folks exposed to lead, but I don't think lead is going to make those things less effective. And if anything, you can change that lifestyle type risk.

John Moe: Right. You can't change the amount of lead that you got when you were a kid, but you can change what you do about it now.

Aaron Reuben: Exactly.

John Moe: Dr. Aaron Reuben, thank you so much.

Aaron Reuben: Such a pleasure. Really appreciate it.

Music: “Building Wings” by Rhett Miller, an up-tempo acoustic guitar song. The music continues quietly under the dialogue.

John Moe: Dr. Aaron Reuben is an NIH National Research Service Award postdoctoral scholar in Neuropsychology and Environmental Health at Duke University.

Science is good, and I believe in it. Humans ought to. Yeah, science was behind the idea of putting lead in everything once upon a time. It was also responsible for eventually realizing how dangerous this substance is.

Now, a couple weeks ago, we had comedian Ellie Hino on the show, and she talked about being in mourning for a life that she could have lived if she'd only realized she had ADHD a lot sooner and gotten it treated a lot sooner—the things she could have accomplished, the bold moves she could have made if she had this under control at a much earlier point in her life. I kind of feel the same now, having talked with Dr. Reuben.

If I didn't have those mental illness points he described, if I had those extra 4 to 6 points of IQ, what could I have spent those points on, given the choice? Math, probably. I always struggled in math. And it doesn't work that way. Lead happened. Still, it's maybe a little nice—just a little—to know that sometimes things like mental illness or math trouble just happen to you. Maybe because of lead, maybe something else. But it's not a result of you not studying enough, or being lazy, or some other moral failing that we attack ourselves with. You didn't control it. You were just there when the lead hit. It's not your fault.

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[00:45:00]

That's happening on Facebook. Lots of good people hanging out there, talking about mental health, talking about the show, supporting each other, giving each other ideas. It's a good place to hang out. I like to hang out there too. Just search up Preshies on Facebook. Our electric mail address is DepreshMode@MaximumFun.org.

Hi, credits listeners. Led Zeppelin took its name from a comment by Keith Moon, drummer for The Who, who predicted the band's music would go over like a lead balloon. Jimmy Page thought Zeppelin sounded more poetic than balloon.

Depresh Mode is made possible by your contributions. Our production team includes Raghu Manavalan, Kevin Ferguson, and me. We get booking help from Mara Davis. Rhett Miller wrote and performed our theme song, "Building Wings". *Depresh Mode* is a production of Maximum Fun and Poputchik. I'm John Moe. Bye now.

Music: "Building Wings" by Rhett Miller.

I'm always falling off of cliffs, now

Building wings on the way down

I am figuring things out

Building wings, building wings, building wings

No one knows the reason

Maybe there's no reason

I just keep believing

No one knows the answer

Maybe there's no answer

I just keep on dancing

Adam: Hi, this is Adam Leibert Johnson from Long Beach, California, and your struggle is valid.

(Music fades out.)

Transition: Cheerful ukulele chord.

Speaker 1: Maximum Fun.

Speaker 2: A worker-owned network.

Speaker 3: Of artist owned shows.

Speaker 4: Supported—

Speaker 5: —directly—

Speaker 6: —by you!