

TPWKY – Ep 211 – Motion Sickness

[00:00:00]

Kristina: My name is Kristina Kupka Decker, and for as long as I can remember, I have experienced motion sickness in cars, planes, boats, trains, and theme park rides. The first time I experienced severe motion sickness, however, was when I was 16 years old on a flight from Los Angeles to New York. As soon as the plane took off, I was hit with intense vertigo and nausea. Within about 15 minutes, I began vomiting, which quickly turned into dry heaving for the remainder of the six-hour flight. The plane suddenly felt smaller, breathing felt heavier, and my head was spinning so intensely that it felt like it might explode. I felt overheated, overwhelmed, and my mouth was either extremely dry or excessively watery.

I am now 37, and unfortunately, this has never changed. The difficult part is that I love to travel, so in many ways, traveling means accepting that I will likely suffer through the journey. Over the years, I have seen many specialists, including neurologists and ear, nose, and throat doctors. I have tried vestibular therapy, had CT scans, MRIs, and undergone hearing tests. Doctors ruled out Meniere's disease, which causes symptoms similar to what I experience. Despite all of these evaluations, no one has been able to explain why my motion sickness is so debilitating. Even when I am the one driving, I sometimes experience nausea and vertigo, especially on winding roads or in heavy traffic, which is nearly impossible to avoid while living in Los Angeles.

One of the worst happened during a flight with very heavy turbulence. I was vomiting into a sickness bag only to realize too late that the bag was broken at the bottom. I had to sit there with vomit in my lap and around me for a large portion of the flight because the turbulence was so bad, the flight attendants couldn't get up to help me. When I finally reach my destination, I usually can't eat anything. I typically need to sleep off the motion sickness before I feel well enough to explore the city I traveled so far to see. The only treatment that has consistently helped me is a combination of Zofran, meclizine, and a wrist device that uses electrical shock therapy, kind of similar to a TENS machine. Even with this combination, I still experience severe motion sickness. But it significantly reduces my vomiting and makes travel somewhat more bearable.

EW: Ooh, Kristina, thank you for sharing your story. First

of all, that sounds, that sounds unimaginably awful,

EAU: sounds awful.

EW: but I'm glad that there's finally some something that you're finding Some relief

EAU: modicum of relief. Yeah.

EW: But thank you again for sharing your story. We really appreciate it.

EAU: we do. Thank you.

EW: Hi, I'm Erin Welsh,

sh

EAU: I'm Erin Allmann Updyke

EW: and This is Podcast Will Kill You

EAU: Welcome to Motion Sickness.

EW: Welcome. This is one of the most universal experiences of humans, right. I mean,

EAU: I mean, yeah, I guess maybe.

EW: Or like the potential for universality is quite

EAU: It exists about

EW: just to, you know, be precise about it.

EAU: it. I am, um, really excited about this episode and when you proposed it, and I think that you have many times

EW: like three years ago was the first time I was like,

EAU: probably,

EW: Yeah.

EAU: like, absolutely not. And I am thrilled that I finally, um, said yes to it because it's really, really interesting.

EW: I finally bullied you into it. I

EAU: I don't,

EW: doing, it's on the calendar.

EAU: it was,

EW: no.

EAU: it's, it's super, super interesting.

EW: Yeah,

EAU: I'm really excited about it.

EW: It is. I, I like what, what drove me always to be like, we should do this. It's not because I knew anything about it. It's not because I personally have experienced a lot of motion sickness. I really.

EAU: you get, do you get motion sick? No.

EW: at all.

EAU: Mm-hmm.

EW: Was, Jon and I were, uh, fishing off like in, in, in the ocean

EAU: Mm-hmm.

EW: boat And the waves were quite choppy. And Jon quickly, 'cause his eyes were focused on the rod and not the

EAU: And the fish, yep. Mm-hmm.

EW: I don't know how much time scream, barfing, poor

EAU: Scream, Yeah.

EW: you know, just And I was, and he was like, you are completely fine. Like, I, I [00:05:00] felt nothing.

EAU: Yeah.

EW: for him, but like physically I felt, felt nothing. Uh, so yeah, I am, I am, I am one of the ones who can read in a car, on a bus, on a train, whatever. No problem. Yeah.

EAU: I, uh, I can remember one time feeling a little bit motion sick and it was on day two of a 22 day research cruise in the middle of the ocean. Um, and yeah, day two I was like a little like, Ooh, I don't think I'm gonna eat today as much as usual. was it.

EW: Yeah.

EAU: So I feel very lucky, um, that I haven't experienced a lot of it. 'Cause otherwise I'm like, I'll eat an entire funnel cake and then go on the tilter Whirl and be like, this was the best day ever. So.

EW: Rollercoasters. I remember As a kid, the one time i remember really feeling quite nauseous was on a bus, on a school bus, reading a book. Um, because I had no friends, so I would just read books on the school

EAU: Oh, baby Erin.

EW: Yeah. And, so I, I remember that. But, um, but then ever since then, which is is interesting 'cause I feel, anyway, we'll, we'll get there. In terms

EAU: Yeah.

EW: Distribution, there's

EAU: yes. There's so much. I'm really excited about it. Maybe we should start and stop just blathering

EW: we should, maybe we should. Uh, we have quarantini time.

EAU: Quarantini time.

EW: Time. What are we drinking this week,

EAU: We're drinking motion potion.

EW: The motion potion. It's ridiculous. And it is ginger based, essentially. However, listen to our ginger episode. This is not curative or

EAU: there's,

EW: any means.

EAU: also like very little data that Ginger is helpful for nausea associated with motion sickness, like in particular just,

EW: This is also,

EAU: it's tasty.

EW: I mean health myths.

EAU: Our Health Myth episode talks about ginger.

EW: on Ginger. but it's, yeah, so it's, it's ginger ale, it's lime juice, it's mint, it's candied ginger. It's, you know,

EAU: I tasty little bev.

EW: Really, really tasty.

EAU: You can find the recipe on all of our socials where we are. This podcast will kill you, I think mostly is our socials

EW: maybe TPWKY

EAU: T-P-W-K-Y, who knows?

EW: I'm not

EAU: Um, also, we'll probably post it on our website. This podcast will kill you.com. Have you checked it out? We have a whole bunch of stuff there.

EW: out.

EAU: The end

EW: The end website. We

EAU: webs?

EW: into

EAU: No, we said it,

EW: spiel.

EAU: it's there.

EW: Let's get to the good stuff.

EAU: Right after this break.

EW: Jinx.

EAU: I actually wanna start this section with a quote.

EW: God. I do the same thing.

EAU: I was gonna say, like, this is really your vibe, but I'm stealing it a little bit. Okay. Um, this is a quote from a 2006 paper by Shupac and Gordon. And

EW: Okay.

EAU: it describes the constellation of symptoms that we can see in motion sickness. And I really like it 'cause I think it just like sets us up to really like picture what it is that we're talking about today. You ready?

EW: I feel like I'm gonna get sympathy nausea, which

EAU: Maybe?

EW: That I do

EAU: Yeah.

EW: get

EAU: Yeah.

EW: am I, is, is the dog gonna barf? Is

EAU: Really?

EW: in the boat?

Yeah.

EAU: you feel nauseous? I, if I smell vomit then it will make me nauseous, but otherwise, yeah.

EW: Okay.

EAU: Okay. Anyways. Here we go. Ready?

EW: Yeah.

EAU: The development of motion sickness. Sorry, it's kind of a long quote, just so you know

EW: Okay. I'm I'm

EAU: it's worth it. Okay. Quote, "the development of motion sickness symptoms follows an orderly sequence that varies with the intensity of the stimulus and the susceptibility of the individual. The initial symptom is usually discomfort around the upper abdomen. 'Stomach awareness.' This is in quotes,

EW: okay.

EAU: which is followed by nausea and increasing malaise. Concurrently. Perioral, that means around your mouth and facial palor appear

EW: Mm

EAU: accompanied by cold sweating. With rapid worsening of symptoms, there can be salivation changes, feeling of body warmth, dizziness, retching, and recurrent vomiting. Lethargy, fatigue, and drowsiness can persist for hours after

the motion stimulus ends." End quote. I feel like it really walks us through what it looks and feels like to start having motion sickness.

EW: it does,

EAU: You're

EW: I have so many questions now. No,

EAU: Don't ask any of them yet.

EW: Yes.

EAU: Um, I also wanna mention that there's another kind of phenomenon that we see described alongside motion sickness. That's called Sopite syndrome. I think that's how you say it. Um, and it's this kind of like drowsiness, lethargy, like decreased cognitive motor functions. Um, a lot of times we see it marked by yawning, like an increase in yawning.

EW: Mm-hmm.

EAU: And this can persist it can start with the motion stimulus itself, and then it can [00:10:00] persist for like an a long time after, in some cases. People can also get things like eye strain, difficulty focusing headaches, um, and things like that. So. Motion sickness overall is this feeling of unwellness

EW: Mm-hmm.

EAU: and a lot of times nausea and vomiting specifically that we get that is associated with motion or movement. And like we read in all of that description, while it very classically like nausea and vomiting and things are like that kind of first part of the symptoms, there's a really wide array of how people can present with motion sickness overall.

EW: Hmm.

EAU: But it's not just any motion that triggers motion sickness,

EW: it's not

EAU: it's specific types of motion because we don't tend to get motion sick when we're walking or running or riding a bike, but we do, if we're on a boat or a train or sitting in the backseat of a car. And motion sickness can also be caused by perceived motion, as in people can get motion sickness from things like virtual reality or like really immersive 3D movie screens without moving at all imax. So what in the absolute heck is going on that causes us to get sick from movement or the perception of movement?

EW: of movement,

EAU: I'm really excited to try and tell you that's what I'm gonna try and do right now, just so we know. So first of all, we don't really know. That's just like, I'm gonna say that at the front. Um, we like, we, we think that we know. And the uh, um, overall consensus hypothesis idea is that there is some kind of sensory conflict.

EW: right?

EAU: That's what it's called, between the actual sensations that, that you are receiving into your brain

EW: Mm-hmm.

EAU: and what your brain expects to be receiving.

EW: Yeah.

EAU: And these conflicts can happen between a number of different sensory systems or a number of different, of like ways that we perceive things around us. So the main sensory systems that are involved in motion sickness, let's dig into them a little bit, are the visual system, the vestibular system.

EW: Love the vestibular system,

EAU: it's quite exciting and the proprioceptive system. So we're gonna talk about these three.

EW: system. I love 'em all.

EAU: Listen, we're here for our sensory systems. Okay, so our visual system is obviously our eyes, right? These are perceiving the world around us visually.

They're sending the inputs that they receive into the visual centers of our brain in order to map out the world. I'm not gonna dig much deeper than that. Our eyes also have quite a lot of reflex movements and things built in that we are totally unaware of,

EW: Yeah,

EAU: that if we turn our head or experience any kind of motion, our eyes are actually making teeny, tiny micro adjustments in the opposite direction of whatever our movement is so that our visual field stays steady.

EW: Learned about this recently when interviewing someone for an episode of Advances in Care on concussion detection

EAU: Yeah,

EW: not have a good system right

EAU: no.

EW: Concussions. And so

EAU: Mm-hmm.

EW: So one of the thoughts is that we can detect it potentially with these small eye movements, because when we get a concussion, sort of all of these little, all of these sensory systems are disrupted a

EAU: Yep.

EW: can we detect severity, intensity, duration, whatever, of a concussion with these eye movements.

EAU: Yeah.

EW: There's so much there. It's just really cool. It's just so cool.

EAU: So this, our eyes making these little micro-adjustments, it's part of what is called the vestibulo-ocular reflex. So that means that our eyes are connected to our vestibular system, okay? And this is the system that detects the position and movement of mostly our head in space. It is a complex system and we don't

need to get like, deep into the weeds of It, but the peripheral parts are located in our inner ears Okay.

We have these two teeny tiny organs called otoliths that are not just little rocks, but they're actually teeny tiny little organs that detect movement specifically in the forward backwards and the side to side, direction not, yeah. Yeah. Not rotating. Mm-hmm. And then we also have three sets of, on each ear these things called semi-circular canals that are these little fluid filled tubes arranged in different planes. They look like, um, I don't know, like, you know, those fancy French cookies, like palmiers or whatever.

EW: No, like a grape cluster.

EAU: No, no, [00:15:00] no. uh. Google a picture of it. Okay. They're like little canals. Anyways, they're in our inner ears as well. They're filled with fluid and they sit at different angles, so they detect rotational movement. Okay? So like looking around you, rotational movement. Cool

EW: head side to side

EAU: like looking to your left, looking to your right. Yeah. Okay. Okay. And all of these together our semi-circular canals our otoliths. They are involved in sensing the position and the movement of our head, and they are obviously connected directly to multiple different parts of our brain. And they are involved in this vestibular ocular reflex. So they're connected to our eyes to help with these little movements. And something called our vestibular spinal reflex,

EW: Ooh,

EAU: us to maintain head and postural stability, making these little compensatory body movements that again, we don't really notice or recognize, when we are moving our head in space. Okay. Uh, some of the parts of the brain that are very involved in this vestibular system are our cerebellum, which is the bottom, like back part of our brain. I have a brain, but I'm not gonna reach for it 'cause I'll knock it over.

EW: I

EAU: And then,

EW: here

EAU: oh yeah, there you go. It says the bottom, the back. You see that little back bit. Okay. We also then also have proprioception. Okay. Proprioception is our ability to know where our limbs and other body parts are in three dimensional space,

EW: such a mysterious sense. I

EAU: isn't it? Uh, it's mostly gathered from like mechano receptors that again, we don't recognize or notice, but there are things all around our body that integrate into our brain to tell our brain whether you can see it or not. You know where your hands and feet are. All right. Okay. So to know and understand where we are in space and how we are moving through space. Our eyes, our vestibular system and our proprioception have to all work in concert and they work based on kind of like maps that we have developed in our brain by existing on the earth thus far. Like our brain knows that gravity is a force that is always present and whose vector points down towards the earth, right? We don't have to think about it. We literally don't feel it, but it is always something that our brain and our body is responding to because it's a force that we're always exposed to. So. When this system is working well, for example, we might be walking with our eyes open as sighted individuals. Our eyes are going to perceive that we are moving through the world where the horizon and the stuff around us is remaining relatively fixed, right? Like it is. It is moving past us. Our vestibular system is perceiving our head moving through space. Little tiny micro adjustments are being made, and our proprioceptive system perceives that our limbs are propelling us forwards. We're standing upright. Gravity is directing downwards. The horizon is there. Everything is great, and we experience no sensory conflict whatsoever.

EW: Uh, but

EAU: However, if instead we are on a boat on the ocean and we are sitting inside of our cabin, for example. Then our vestibular system senses quite a lot of movement, right? There's changes in velocity, there's changes in direction as this boat is moving upon the waves. But if we're sitting inside of our enclosed cabin, our eyes are perceiving that the world, the cabin inside the boat, or even worse, the book that we're sitting there reading inside of the cabin, inside of the boat, the boat around us is too fixed because it's moving the same way that our body is moving instead of our body moving through space. Like if we were walking.

EW: Yeah.

EAU: Does that make sense?

EW: Yeah.

EAU: Those two senses, our vestibular system and our visual inputs are in conflict, and they're not what our brain expects to be perceiving. This causes a cascade of hormones and neurotransmitters and things to be released, telling our brain, whoa, whoa, whoa, whoa. Something is not right. We should panic ahhh.

EW: Yeah.

EAU: ensues.

EW: But like, okay, why is this a bad thing?

EAU: Why is this a bad thing?

EW: this is where like, and I, I know that it is not, nothing has to be good or bad. It

EAU: Yes,

EW: our bodies don't have not evolved in this space before to anticipate these changes

EAU: yes.

EW: to, and then get rid of the conflict, deescalate the conflict. Um, but why does it result in these nausea, et cetera, you know? But why?

EAU: But why, but why is a question that we [00:20:00] absolutely do not have an answer to. Like, we do not know why

EW: Okay.

EAU: I've read

EW: I've, I've read some and we can talk about it if you want later on, like the, the hypotheses.

EAU: I have them if you'd like. Yeah. So we, yeah, we, we don't know why there are a lot of hypotheses. Um, there's one that's like, maybe we get nauseous especially, and have vomiting as a byproduct of like our toxin defense system

EW: I

EAU: where

EW: one, but

EAU: no, it doesn't really have any evidence for it. It's this idea that like our vestibular system gets activated by these movements and it triggers the same response that we would have from exposure to toxic substances. Um, it doesn't, it doesn't really make any sense.

EW: your sensory inputs, if you have some sort of like neurotoxin that you have ingested or consumed in some way, then it's possible that all these different things would be off. Your perception would be off. You would be like, I'd

EAU: Exactly. It's just like an, an accidental, right? But no, it doesn't make sense. We're discounting that one. Um, most of the papers do too. It's not just us. Um, there's also this idea that we have just this inappropriate activation of like our autonomic system, um, with like our vestibular system interacting with our autonomic system and causing this dysfunction. Ah, there's again, not like a, a really clear evidence of this.

EW: Mm-hmm.

EAU: there's some thought that maybe it's just a byproduct of the proximity of our vestibular system and these like motion detectors to where our vomiting circuitry also sits. Like we have multiple, sometimes people say we have a vomiting center, and that's not quite true, but there are multiple brain areas that are involved in nausea and vomiting,

EW: I have never heard anyone say we have a vomiting center,

EAU: it's in a lot of the papers. They're like,

EW: you. I believe you.

I just

EAU: but,

EW: this is funny

EAU: but it's not just one, it's like multiple parts of our brain that are involved. So is it just like this kind of spillover of the inputs happening to be there? I dunno. We dunno.

EW: It's, I, I think that like, what, what seems likely is that it's not an adaptive response. It

EAU: Yeah.

EW: just something that like syn. I, I mean, and maybe that's really unsatisfying. and so we keep looking for hypothesis that make more sense or

EAU: Right.

EW: us more of an answer or a story. But I think it could just be that it's a maladaptive response to this thing that we did not evolve experiencing,

EAU: Right. And it's just, and it's, it's this, uh, response that different people get at different levels depending on the circumstances in which they're exposed to these potentially nauseogenic movements, which I think is a great word.

EW: Let's, talk about these circumstances.

EAU: About them a little bit 'cause there's some other ones too. Okay. So we talked already about if you're sitting still, uh, you're sitting and the world is moving around you, but it looks like the things around you aren't moving the way that you expect. So that's one type of mismatch that we might see. Um, another that we might see would be, if you're, again, on a boat, but you're standing out at the side and you're looking over the side of the ship, your body is moving one way. Your eye, your head is moving one way. Your vestibular system is saying there's this kind of movement happening, but your eyes are only seeing the waves going up and down. Across the ship. that's another way that you might have this mismatch.

EW: That was poor Jon, I think

EAU: Yeah, exactly.

EW: guy. It was, it was. It was brutal. It was awful.

EAU: sounds, it sounds really bad,

EW: soon as he was on land, he was like, I'm fine.

EAU: of course,

EW: after a while,

EAU: a

EW: like, yeah.

EAU: Um, the, but then we also, like we said at the very beginning, can have this conflict if you are sitting completely still, but watching an immersive like VR or 3D movie on a large screen because then your visual systems are telling your brain, we are moving rapidly through space and your body and your head are sitting still. Right? This is sometimes called pseudo motion sickness or cyber sickness, which I think is a silly, very silly.

EW: from the net or

EAU: Right. It is completely ridiculous. So this is the kind of working theory, working hypothesis really, of how motion sickness happens. That we have these conflicts or what's sometimes called neural mismatch. And these three systems, visual, vestibular, and proprioception can all be involved. But the vestibular system in particular is probably the most important and kind of must be involved. People who have complete lesions of their vestibular systems, like not functioning vestibular systems bilaterally, it's near impossible to get motion sickness. But people who are blind or lack visual inputs entirely, or sighted people who are blindfolded can still be susceptible to motion sickness even without seeing right.

EW: very interesting.

EAU: Exactly. And so it's in part because again, we have two different parts of our vestibular system in what is sensing [00:25:00] rotational movements and what is sensing lateral and forward and backward movements. And so even if

you have a conflict between these two parts of your vestibular system, that alone could be enough to cause motion sickness in some cases. And what kinds of motion is it? Why do we get motion sick on a boat, but not on a bike? Right. Part of it is active movement, right? When we are propelling our own bodies, we are less likely to get motion sickness. Why? Is it Because our brains are more like ready to accept that this motion is coming from us. So even if there's a discrepancy, our brain is accepting it.

EW: There's

EAU: don't have,

EW: the volition,

EAU: yes.

EW: Idea where it's like, oh, if you're driving the car does that make you less likely if

EAU: Right.

EW: If you're riding the bike, propelling the bike?

EAU: Exactly. it's probably not that when it comes to bikes and things because not all types of motion tend to cause motion sickness.

When we think of motion sickness, most of us think of a boat. I've used that as an example a lot, and seasickness is like the most infamous. But on a boat, despite the fact that we are subject to a whole bunch of different kinds of motion, it is only the low frequency heave motions that you have on a boat that like, that was not a good example, but you know what I'm saying. It's the heave motions that are the trigger for motion sickness. We don't see motion sickness walking, bike riding, horseback riding, much less common to have motion sickness, camel riding, elephant riding, much more likely to have motion sickness.

EW: glad you mentioned camels. I mentioned it too,

EAU: Camels. And the difference in these types of motions is the frequency of these movements. So lower frequency movements, so anywhere from like 0.1 to 0.5 and especially 0.2 hertz or 0.2 cycles per second movements tend to be

substantially more nauseogenic than higher frequency movements, especially movements that are faster than one hertz or one cycle per second.

EW: So is this, are we talking forward motion or up and down? I don't really understand how

EAU: It so it

EW: work,

EAU: honestly, there was so much physics in this that I have a hard time also because it can be movements in any direction. So this could be up and down movements, it could be forward, backward, translational movements. It could be rotational movements like coriolis type of movements, but it's all about the, and like different ways. Especially when it comes to like horizontal and spinning type of movements. If you do them in a certain way, even at different frequencies, then you could trigger motion sickness. But in general, especially for up and down movements and forward backward movements, it's these, um, lower frequency. Like you think of how an elephant moves versus how a horse moves. I'm, I'm bouncing up and down a little bit.

EW: I think I, I, I think that makes sense. sense. where

EAU: Yeah.

EW: deeper

EAU: It's deeper, slower. Yep. Longer. Longer frequencies. Longer wavelengths.

EW: I assume camels can jog, trot.

EAU: Yeah. Maybe you're less likely to get that. I don't know. But is it also that like the way that you're sitting, like it's side to side movement is also different than what you would have on a horse? I don't, it's like really interesting and I don't fully understand.

EW: might be different for different people and

Yeah.

EAU: Um, and like people have proposed hypotheses again as to like, why is it that these low frequency movements are the ones that are more nauseogenic? And so it's thought that maybe for some reason that, again, is it just this like mismatch type of thing that these frequencies just happen to be where we have more of these errors in signaling between our vestibular systems and our other somatosensory systems. We just have more errors between what we sense and expect in terms of our verticals or in terms of our horizontal movements. Some people propose that this type of frequency, these low frequencies, are like the limit of human body motion. So we can't figure out how to maintain stability of our bodies at these frequencies because our bodies don't move at those frequencies very often. But I, I don't know.

EW: Don't know. Yeah.

EAU: Other people say that maybe at these low frequencies, our brain can't interpret, um, these type of accelerations as movement through space. So it's interpreted as a tilt in the force of gravity, which is like our brain going, oh, why are we upside down when we're not really upside down at all? So then that confuses our brain. I dunno, it's all quite confusing. And then like, what happens next is also still confusing. So I said that there's like a series of signals that get sent right to our brain via a bunch of different neurotransmitters. Acetylcholine is involved, histamine is very involved, and we, we still don't really know, like, [00:30:00] uh. Why, why, like, why exactly is this happening? But in, in the, the end result is that our autonomic system gets activated. Different regions of our brain involved in vomiting. Our vomiting centers get activated. Um, and especially areas of our brain, like our lower brain in our cerebellum as well as parts of our brainstem end up getting activated. And we see this drop in our stomach fundus. We see relaxation of our sphincters, we see gastric stasis, so things are moving slower. And then, you know, vasodilation versus vasoconstriction, which is why we have the palor and sometimes cold sweating.

EW: Oh, okay. Okay. Okay. So, so this is, this is truly a cascade of a multiple different, multiple different signaling pathways,

EAU: Ah, pathways. Just not kind of working in concert. Yeah.

EW: And then that is causing all of these def these, these different effects like nausea,

EAU: Yeah.

EW: Uh, palor, like cold sweats. What

EAU: Yep.

EW: sweats? How, how, what is, yeah.

EAU: Well, like you're not, like you don't have a fever. You like feel cold, but you're sweating.

EW: Yeah.

EAU: cold sweat.

EW: But like, what is the cause of that?

EAU: Oh, I dunno. Like, don't, you know,

EW: Okay. Like I've, I've experienced cold sweats, many A,

EAU: A, you've never had a cold s sweat.

EW: Cold, so like, tell me, um, but, and, and so Palor makes sense because you're kind of, you're just draining blood and then

EAU: Yeah.

EW: that blood going? What?

EAU: Well, and some of that is stuff that we just see with nausea in general. Right? And so some of that is just like directly involved in the, in the nausea response. Even when you get nausea and vomiting from a toxin or from an infection or from chemotherapy or whatever it is.

EW: Hmm. Okay. So,

EAU: okay.

EW: So there are multiple different things. I mean, so there's like nausea and then like the constellation of things that often happen with nausea.

EAU: Yep.

EW: then there are other effects that might or may not be directly as closely tied to nausea

EAU: Uhhuh.

EW: that cascading pathway. Medications, preventatives. Do they work on the same root source? Can they control everything? Yeah.

EAU: Excellent questions, Erin. So, um, the best treatment. Is prevention. And that's often not possible. Most of the non-pharmacologic methods that we have are like behavioral, right? So that's things like looking at the horizon, like, like you were saying, fresh air. There's a lot of things that they market that are focused on the idea of reducing conflicting sensory input. Or like providing other sensory input for you to like be distracted or, or things like that.

EW: okay.

EAU: Um, you know, whatever. But like the idea of looking out at the horizon is that you're like reducing visual, sensory conflict, right? The horizon is not moving. It's fixed the way that you expect it to be. And so then that's gonna help reduce some of that sensory conflict. There's a lot of like acupressure, band like bands that you can wear. And there's very mixed data on whether or not these, uh, have any actual effect. But some people find them helpful and there's like no side effects with them. And the biggest downside of all of our pharmacologic methods, so like drugs to treat motion sickness or prevent motion sickness do tend to have quite a lot of side effects,

EW: Mm-hmm.

EAU: especially drowsiness, which is a huge problem if you're the one like flying the plane or driving the boat or whatever.

EW: Yeah.

EAU: But they do tend to fall in kind of two main classes that work on two of those receptors and neurotransmitters that I mentioned already, which is like acetylcholine

EW: Mm-hmm.

EAU: Histamine. So antihistamines and specifically antihistamines that can cross the blood-brain barrier because they have to be able to get into our brain

and central nervous system to have an effect, can block histamine and then reduce a lot of the symptoms that are associated with this. Because histamine is involved in all of the action going on. Okay?

EW: interesting. okay.

EAU: That's what Dramamine, if you've heard of the brand name Dramamine, which is Dimenhydrinate that's an antihistamine not dissimilar to Benadryl or diphenhydramine. And both of these can be effective for motion sickness, but they tend to cause like dry mouth, dry eyes, drowsiness, et cetera. So they're, that's a downside. So the other big one that we use is scopolamine, and this acts on acetylcholine receptor, so a different type of receptor. And we think that it acts kind of on both sides. We don't exactly know, but we think that it acts both on the vestibular side and the the vomiting center side of the transmission pathway where our vestibular system is talking to vomiting parts of our brain and saying Be nauseous. So scopolamine is working on both ends of the spectrum. In that way it tends to have quite a lot of side [00:35:00] effects, especially if you give it as an oral medicine. And so we often use it as a patch that you put behind your ear.

EW: okay.

EAU: Um, and there's also like a nasal spray formulation. I think too, the nice thing about the patch, even though it takes a lot longer to kick in, is that if you know I'm gonna be on a cruise for the next five days, you put it on a few hours before the start of the cruise and then it lasts for 72 hours, which is kind of nice because usually by that time you've acclimated. And habituation or acclimation. Uhhuh is like the best thing that you could possibly do to treat or, or deal with motion sickness.

And what I think is really interesting about the idea of acclimation is that it, the fact that we can acclimate, that we can get used to these motions over time, kind of also lends support to this idea that it's a sensory conflict to begin with.

EW: because you're kind of disentangling these conflicts and

EAU: brain is getting used to a new normal, right? Where it's like, oh, it is okay that the, that all of my environment is moving along with me. I don't have to worry about this. And if you've ever been on a long cruise, or like people who go to outer space and come back, apparently get this a lot, there's something called mal de débarquement or like you get your sea legs. Yeah. And that's when it feels really disorienting to walk on flat unmoving ground

EW: Yeah.

EAU: You've been in outer space or on a boat for a really long time. And that's like you've acclimated, you've habituated to this sense of movement and now you're back on flat ground. Your brain's like, whoa, whoa, whoa, whoa. This isn't what I expect to happen right now. Isn't that so interesting?

EW: Yes.

EAU: That usually gets better a bit quicker.

EW: Okay. That

EAU: Yeah. Yeah.

EW: I have a a, a few questions.

EAU: it to me.

EW: habituation, acclimation, how long does it take is, that's one of the questions I'm,

EAU: Okay.

EW: the rest for after.

EAU: It, it depends on the person, right? Everyone is so differentially susceptible to motion sickness. It depends on the person, but usually, like, even if you are, let's say on a cruise, it's the first like 12 to 24 hours, that things are probably the worst. And usually within two to three days, you're pretty well acclimated. So if someone, for example, is like in the military and training for like intense flights, you know, with a lot of spinning or whatever, they might need more intensive, like habitation therapy. But if you're just like on a boat or something like that, it's usually within a couple of days that you're gonna habituate. But there's like regimens that people sometimes use to like, get used to something so that even if they're exposed in the future, they don't get as motion sick as they used to.

EW: So is that, is that some, that was my other kind of like question trying to get at

EAU: Yeah.

EW: Can you become less motion sick over time?

EAU: Yes, it seems like yes, based on by doing these habituation routines, which can sometimes be quite time intensive. 'cause you have to be able to like go in a mover jiggle thingy or like

EW: to expose yourself to

EAU: over and over and over. Yeah, exactly. Yeah.

EW: Differential susceptibility.

EAU: Yeah.

EW: Why is, are there genetic links? Does it run in families? Uh, and then age

EAU: Uhhuh, uhhuh, uhhuh.

EW: it to me.

EAU: I can't wait. So anyone can get motion sick given the right set of circumstances. We think,.

EW: Okay.

EAU: Astronauts, like you think an astronaut has to go through so much training, but some of the papers that I read said that like 70% of astronauts going up for the first time will have some degree of space sickness the first 24 hours that they're up there. So everyone under the right set of circumstances, you could probably provoke motion sickness, but some people. Like Kristina in our firsthand account, get really severe motion sickness with things that other people don't feel motion sick at all. We don't really know what it is about one person that makes them more susceptible than another person. And we don't have tests or things that we can do to try and guess, are you going to get motion sick or are you not?

EW: Huh.

EAU: There does seem to be a big heritability component. So twin studies have like 70%, so it's estimated like 50 to 70% concordance. Um, especially in childhood and age ranges usually susceptibility to motion Sickness doesn't really develop until age, like six to seven. Babies are like considered immune entirely, but we don't know if it's just 'cause they lay there flat like a potato and they can't really move.

EW: if it's, well, first of all, their sense, their senses are still being

EAU: Right. Their cerebellum is a disaster. They can't see like, yeah, it's,

EW: also they're being carried around a lot, and

EAU: it. Exactly.

EW: That was that like, but

EAU: Yeah.

EW: it's

EAU: And they were in the womb for so long, like the, in your uterus in it floating around in fluid. So they're just all bleepy de bop maybe.

EW: Oh, they expect motion.

EAU: Right. So I don't know.

EW: I

EAU: But it tends to not [00:40:00] develop until age six to seven and then it actually peaks in like age nine to 11. So like kids tend to be the most motion sickness.

EW: on the bus.

EAU: Exactly. But obviously many adults still experience motion sickness. Though the like rates of it does decline and the severity tends to decline into adulthood, people who are assigned female at birth are much more susceptible, we think, than people assigned male at birth. But we don't know why. Like there's not any clear reasons why. And like I said, like sight is not required for

motion sickness, so people who are blind can still get motion sick. We do know that there's some associations with like migraines, um, and some other, especially vestibular migraines, but also some other like vestibular disorders and an increased susceptibility to motion sickness. But we don't really know why. Like is it overlapping pain pathways? Is it overlapping autonomic reactivity? We don't really understand these associations, but we just see that they exist in the population.

EW: Yeah. Ooh.

EAU: Like, I think one paper found like 35 possible, single nucleotide polymorphisms that might be associated. So like we have no idea what the genetics of motion sickness are. We just know that there's probably some kind of heritability component. So that's motion sickness. Erin.

EW: Very interesting. That

EAU: know, right? It's so weird. It's so weird to think about how, like why do some of our brains, if it's this sensory conflict, why are some of our brains so like on edge about this conflict and making us so sick?

EW: Yeah,

EAU: other people can tilt a whirl after a funnel cake and be like, no problem. I'm not even a little bit nauseous. That's so weird.

EW: It is very weird. Weird is, is the word for

EAU: It's,

EW: motion sickness, it's weird.

EAU: it's weird.

EW: Yeah.

EAU: can you tell me about like how he got to this point? Like I'm assuming it's just human. I can't wait to hear about other animals. Do you talk about that at all?

EW: minorly, but there

EAU: tell me.

EW: there is, some fun stuff to cover,

EAU: Okay.

EW: I'm excited about it. Okay.

I can think of no better way to start the history of motion sickness than with this quote. I had to do a quote, quote. "Whenever we relinquish our intended status as self-propelled animals and step aboard some vehicle or device that transports us passively, we incur the risk of motion sickness. This wretched and debilitating condition has always been intimately linked with man's technological efforts to improve and extend his natural powers of locomotion."

EAU: That's a great quote, Erin.

EW: a great,

EAU: It's really good. Yeah.

EW: those two lines are what kick off the prologue of this book called Motion Sickness by JT Reason, and JJ Brand. And it really gets straight to the heart of the matter. sickness is a problem of transportation, Specifically being transported by something other than yourself.

EAU: Yeah.

EW: And we might use different names to refer to the sickness caused by the specific mode of transport. So like seasickness, car sickness, air sickness, space sickness,

EAU: sickness.

EW: But they, they all signify an external source and

EAU: Mm-hmm.

EW: An almost uniquely human experience, unless you're a dog on a road trip, for example.

EAU: Uhhuh Or a fish in a fish tank

EW: a fish in a fish tank does happen.

EAU: does happen. I learned that and I was like, fish can get motion sick?!

EW: I know it is amazing. It

EAU: It's ridiculous

EW: Given how the vast majority of us are susceptible to motion sickness, and our wide array of transportation options, it's safe to say that we've been dealing with this for quite some time. How long? long?

EAU: I mean forever.

EW: I mean, yes and no, right?

EAU: Okay.

EW: Because our, so our written record on motion sickness extends back to ancient Greece and ancient China at the very least. is that when the first transportation devices were used? If for humans we have to have some sort of external transportation?

EAU: Yeah.

EW: When was that? It was before ancient Greece and ancient China. So I started to look for when the earliest boats were built, thinking, okay, that's a likely candidate for the oldest method of artificial transport.

EAU: Okay.

EW: then I realized that it wasn't about the boat necessarily, boat, raft, whatever. I, the real question was not about how ancient humans spent time on the water, but when they did, that likely dates back to at least 50 to 60,000 years ago.

EAU: Seriously?

EW: Seriously. So it was then that early modern humans migrated [00:45:00] over water from southeast Asia to a landmass called Sahul, which is Australia and New Guinea joined with a land bridge because water levels were a lot lower then.

EAU: Okay.

EW: kilometers of ocean had to be crossed with seaworthy vessels,

EAU: So they had to have gotten seasick. Yeah. Yeah.

EW: And prior to this, it's thought that all other hominid migration had been over land And it's, it's unclear what, as far as I could tell, it's not clear exactly what types of boats were constructed. And it's probably the case that, it wasn't like, 'let's build a boat and immediately go' people were using it for, like coastal exploration

EAU: Fishing and things like that. Local. Yeah. Yeah.

EW: But that is at least, i think a pretty hard line is when humans had to spend extended time on the water.

EAU: You know, they didn't talk about this in Moana at all.

EW: Motion sickness?

EAU: Yeah,

EW: It's been a while I. Uh, no points for accuracy,

EAU: No. Points

EW: points for great songs, zero for accuracy.

EAU: Yep. Yeah.

EW: But yeah, so my, my guess is that there were, there was at least a barfing human or two aboard these watercraft.

EAU: For sure,

EW: right?

EAU: there must have been.

EW: There must have been. Um, but humans, like, like we've touched on briefly, they're not the only animals to experience motion sickness. Dogs, fish, amphibians, primates, and many other animals are also susceptible. And so this points to a deep evolutionary origin of the physiology that makes us all susceptible to motion sickness. And that is primarily our, not primarily, but like a big chunk of it, is the, our vestibular system.

EAU: yep.

EW: And so while those early humans crossing to Sahul might've been among the first of our species to get seasick, they likely weren't the first organisms overall. As an example,

did you know what the leading hypothesis for how New World Primates got from the old world is?

EAU: I dunno, were they like holding onto a coconut or something?

EW: basically

EAU: Yeah.

EW: It's thought,

EAU: floating.

EW: I, I have, I keep checking this 'cause I'm like, this can't be real. It's thought that they crossed the Atlantic Ocean on some sort of big vegetation containing rafts.

EAU: Mm-hmm. Mm-hmm.

EW: They crossed an ocean, Erin. Like how, how did they, how did they do that?

EAU: I, I don't know. And I mean, enough of them to like establish new lineages, so not just like one.

EW: Yeah. Was it multiple times?

EAU: Yeah.

EW: Yeah. And so that, but that is our current best guess based on fossil evidence and what the oldest fossils seem to be related to what primates in Africa, yeah.

EAU: So they probably got motion sick.

EW: Yeah. They had to cross a distance of around 1500 to 2000 kilometers.

EAU: Wow.

EW: they all didn't, like where was the water coming from? Again, I guess giant vegetation raft. If there was enough fresh water in the vegetation and they were consuming that i,

EAU: Right. Or like rain fall. Hmm.

EW: there was an island stopover in between,

EAU: Wow. This is so fascinating, Erin.

EW: So if that's how it went down, definitely motion sickness on the table for these primates, little adventurous primates. But yeah, so motion sickness was not an unfamiliar experience to, well, at least those primates, at least some early humans. But the same goes for ancient humans. So by 800 BCE humans had come a long way in boat, in both boat making and livestock domestication, which enabled the use of carts. And as a result, motion sickness had become a common occurrence, occasionally known as the plague at sea. I'm like, there are so many to choose from.

EAU: I know, right?

EW: Like there's typhus, there's scurvy, there's tuberculosis.

EAU: Mm-hmm.

EW: you know, at least

EAU: There's actual plague.

EW: There's plague, yellow fever, I mean, But various explanations were proposed as to what the cause of motion sickness was. In ancient Greece and Rome, and of course we've got the humors, blamed humors were out of balance. The stomach and your yellow bile.

EAU: Interesting.

EW: playing an outsized role

EAU: Okay.

EW: It wasn't always thought to be bad, the barfing, 'cause

EAU: Okay.

EW: Sometimes emetics were prescribed to be

EAU: Right.

EW: Got, we've got

EAU: It it means you've gotta get rid of this. Yeah. Yeah.

EW: And in ancient China it was thought that motion sickness was due to an improper or impeded flow of qi or life force

EAU: Okay.

EW: With some liver involvement.. Uh, whereas in China, the illness was broken down into the mode of transport, so it was called cart influence or ship influence. In ancient Greece and Rome, the focus remained primarily on sea vessels. Hence the etymology of the word, 'nausea', [00:50:00] which comes from the word for seasick, nau, like NAU for ship, like nautical.

EAU: Like nautical, nautical, nausea, seasickness,

EW: Isn't that cool? I had no idea.

EAU: nausea comes from ships. That's just how, how intertwined they are.

EW: yeah,

EAU: Wow.

EW: The description of symptoms from these ancient texts, spot on, right? We've got dizziness, nausea, vomiting, loss of hunger, exhaustion, anxiety. And while there was no consistent pattern seen in terms of predisposition. Some different writers would try and make a link between disposition and susceptibility

EAU: Mm-hmm.

EW: It was generally observed that people could become acclimated to transport and over time they would be less likely to get sick. Another way to avoid getting motion sick was of course by concocting various remedies or choosing certain diets.

EAU: Oh,

EW: So for instance, uh, grinding up worm wood and mint, and then mixing it with oil and vinegar and rubbing it into your nostrils.

EAU: okay. An odor thing. People have tried a lot of those in, in modern days. There's, there's no evidence for odor things, just so we are clear.

EW: it's, there's a long history of this sort of a thing. Yeah. Others claimed that quote, "seasickness will not be able to torment him. Who drinks vermouth mixed with wine before setting off."

EAU: Ooh,

EW: Not true, Don't give it a whirl.

EAU: Doesn't sound great.

EW: You could also take a bit of earth from your kitchen hearth and hide a bit under your hair or write the character for dirt on your palms, kind of as like a grounding stability. That was another

EAU: Ah,

EW: Another common practice. I know. If all else fails, fast. Just don't, nothing.

EAU: I mean, that is like still a recommendation today is like don't eat heavy meals, et cetera, so that you just have less food to barf up so you feel less nauseous.

EW: Yeah.

EAU: Yeah.

EW: But the sheer variety of remedies or preventatives, it points to just how big a challenge motion sickness posed more than a temporary setback or period of discomfort. It could mean life or death, particularly during war. Julius Caesar wrote that in 48 BCE, when his troops landed on enemy shores after a stormy voyage. They were too exhausted to do anything other than surrender, and they were promptly massacred.

EAU: Oh, whoa.

EW: Yeah. Writings describing the battle of Redcliffe, which took place in China in 207 CE mentioned that seasickness was a big problem, and so the ships were tied together to increase stability. That meant that when one ship was set on fire, they all went up in flames. That's at least with some. Uh, texts suggest

EAU: Whoa.

EW: The plague at sea proved to be a predictable and unwelcome companion to any war since ancient times that involved ships or camels. Apparently, camel sickness became an issue for some of Napoleon's soldiers in the late 17 hundreds. Yeah,

EAU: Camels. Camels. Who knew?

EW: but, but its predictability did nothing to help with prevention or treatment, or understanding why it happened.

EAU: Yeah.

EW: And as transport grew more common beyond wartime, many people had an opportunity to experience it firsthand, such as, famous Charles Charles Darwin. Yeah.

EAU: He was super, super susceptible to motion sickness, apparently, yeah.

EW: So he spent nearly five years on board the beagle, actually more like three years on shore. Two year, like three, three fifths of his time was spent on land, um,

EAU: He's like, "I need recovery time, y'all.

EW: Yeah.

EAU: I'm just looking at birds here." Wink, wink,

EW: yeah. "Oh, that's a really interesting specimen. Let me just spend two months."

EAU: Right?

EW: But, uh, yeah, so this is the, the time then he collected all those observations to, to develop the theory of evolution by natural selection. And during much of his time, he horribly, horribly suffered from motion sickness. So I have a couple quotes from his letters. In one he wrote, quote, "I hate every wave of the ocean. With a fervor. Which you who have only seen the green waters of the shore, can never understand."

EAU: You have no idea what I've been through.

EW: I hate every wave. Charles then this is a little more measured, not really. Quote, " if a person suffer much from seasickness, let him weigh it heavily in the balance. I speak from experience, it is no trifling evil, which may be cured in a week" end quote. And he probably had something else going. Oh, there have been so many different hypotheses

EAU: Mm-hmm.

EW: About what afflicted Darwin, but he had a terrible motion sea sickness. But this didn't mean that [00:55:00] people didn't try to cure motion sickness. There was always the will to explore new options, and to understand what was

actually happening. And so by the late 19th century, scientists and sailors had accumulated heaps of explanations and remedies for motion sickness. Things like, in terms of hypotheses, 'cerebral anemia' or 'cerebral hyperemia'. Basically, irregular blood flow to the brain of some sort.

EAU: Mm-hmm.

EW: Others believed that disturbed vision or respiration played an outsized role. Maybe it was the di maybe it was the digestive system that experienced too much mobility, too little mobility, all things out of balance. Yeah. One guy was certain that it was an infection, just like yellow fever or bubonic plague. and so he wrote this paper, and in response, a reviewer from the Lancet wrote, this is like in 1850 by the way,

EAU: Okay.

EW: "It is a pity that people should so cruelly waste their time and trouble."

EAU: Oh, that brings you right back to grad school, doesn't it?

EW: Reviewer three right there,

EAU: Exactly. Oh man.

EW: completely devastating. Um, a tentative breakthrough arrived in 1881 when a couple of researchers noticed that motion sickness produced very similar symptoms as a condition called Meniere's disease. So it turns out our stomach wasn't to blame. Our blood wasn't necessarily to blame, it was our vestibular system that helps us balance and sense our body's position in space. so, as the vestibular hypothesis grew in support overtaking the blood and guts ideas, others still emerged, such as the psychological explanations, believing that motion sickness was all in your head in like a, "well, you just have a nervous disposition" sense, not in like a, "this is disrupting your vestibular system" sense.

EAU: right. It's, uh, that, by the way, there actually, I found that there have been papers that have very clearly shown there is no like personality component to motion sickness,

EW: I mean, and, and

EAU: which like,

EW: how, how clearly there is no link, there was a paper I read from, I think 1949 that was like so disparaging of this idea

EAU: Mm-hmm.

EW: They were like, 'this is utter garbage'.

EAU: Even, even in the 40s.

EW: Even in the forties. Yeah. When that was still in vogue. Right. but yeah, so supporters of this idea would point to stories of sailors who were completely wrecked by seasickness and then suddenly recovering after hearing that the ship was under fire, or the fear of motion sickness becoming a self-fulfilling prophecy, or the claim that some people's sickness was effectively treated with placebo. Uh, and so under this hypothesis, it was like mind over matter was the only way to go, but these stories were primarily anecdotes, uh, possibly invented. And in general, this neurotic, quote unquote neurotic theory of motion sickness did not gain a lot of traction in large part because yeah, it did not hold up to any scrutiny even then. Even then. So research had shown that almost everyone was susceptible to motion sickness, but not everyone had a nervous constitution, so checkmate, Whatever that means. Whatever that means. Motion sickness again became a pressing issue when war was on the horizon. Specifically, World War II. Cause you've got tens of thousands of soldiers about to be transported over water and spend extensive period on ships or in the air on airplanes, and so motion sickness posed a substantial threat to wartime efforts. We gotta have our soliders in fighting, fighting, phys...

EAU: shape?

EW: Shape. I can't, my brain. But so despite the attention paid to the condition in the century before, little progress had been made in understanding or treating it. To quote this 1948 paper, the same one that was disparaging of the, the psychological links. By Taylor and Bard, quote "The literature on motion sickness which appeared before WWII contains amazingly little factual information concerning this common disorder. Like the extensive folklore devoted to the subject, most of the publications were replete with uncritical considerations of a number of possible etiological factors, and with accounts of uncontrolled and statistically deficient excursions into the field of prevention and cure" end quote, cutting. Just brutal

EAU: Like no one has done anything useful. Thanks a lot, y'all.

EW: You all wasted your entire career studying this. but they weren't wrong, really. Like, there still was not any way to effectively manage motion sickness.

EAU: yeah.

EW: Although people still had their pet remedies. Ranging from the sensible: fasting, dry toast, you know, food choices that are often recommended.

EAU: Right. Mm-hmm.

EW: Uh, or to the, to the confusing, even barf inducing, nausea [01:00:00] inducing, certainly quote, "soup made of horseradish and rice, seasoned with red herrings and sardines." End quote

EAU: What

EW: I actually kind of wanna try that. It sounds, I love horse radish and, and sardines, but

EAU: I do not

EW: know. But that is not something that I would wanna gorge myself on prior

EAU: no. Prior to a ship voyage. Mm-hmm. No thanks.

EW: Uh, that though, I don't even think that was, uh, maybe it's in contention for as bad as the suggestion to feast on pickled onions, which I also love, don't get me wrong. But the idea was to eat so much of them that you had a tremendous amount of gas, so that your stomach maintained a steady pressure. Thinking that it was like an atmospheric pressure thing. I don't know.

EAU: That sounds so uncomfortable

EW: And then all of these were to be washed down with your beverage of choice. You know, top recommendations included coffee, brandy, but the top fave was champagne.

EAU: Champagne?!

EW: Yeah

EAU: The idea of champagne to prevent motion sickness is hilarious.

EW: I know. It's, it's great. There's, there's a.

EAU: So fancy.

EW: I know not sparkling wine,

EAU: No champagne.

EW: champagne, uh,

EAU: Yeah.

EW: That motion sickness book that, uh, I, where I started the quote from in the beginning of this has a table. They put together a table of motion sickness preventatives, and the number of citations for each one in like historical times. So ranging from warm salt water to opium, chloroform to nitrous oxide

EAU: Jesus.

EW: Cayenne pepper to atropine, which is actually kind of funny 'cause that was used,

um,

EAU: Yep, yep.

EW: later on

EAU: Yep.

EW: but none of these had enough support to actually do anything in a major world war. So in the words of one writer from the period quote, "I am convinced that the only real and complete cure is to sit under a big tree" end quote.

EAU: Get off that boat. Just go sit down on the earth. Mm-hmm.

EW: more statistically organized trials on compounds like Belladonna derivatives and barbiturates were conducted during the war, and it's hard to know if the cure was worse than the disease.

EAU: Oh dear.

EW: On the one hand, you've got soldiers reporting that D-Day "had resulted in the greatest mass vomiting ever known in the history of mankind" quote, which makes sense.

EAU: Yeah.

EW: Think about that. The,

EAU: Yeah.

EW: And on the other hand, you've got a war correspondent describing that the seasickness pills prescribed by the Army, quote "not only put us to sleep, but they constricted our throats, made our mouths bone dry and dilated our pupils until we could hardly see." End quote.

EAU: Yeah.

EW: Turns out those guys had taken the twice the recommended dose, so

EAU: Oh,

EW: could have been partially to blame.

EAU: Maybe a little bit of user error there. Okay.

EW: Might be. But also complicating drug development for seasickness was that during this time it was common for the placebo pill to be a lactose pill, which I would imagine could cause symptoms mimicking motion sickness in

EAU: Yeah. If you were lactose intolerant,

EW: Yeah. It was like, well, we tested this against the lactose placebo, and I was like, excuse me?

EAU: Why?

EW: Why? So, yeah.

EAU: Okay.

EW: Unfortunately, true relief for many would not arrive until the war was over. We love a serendipitous discovery in science

EAU: We do.

EW: Makes for great storytelling. So in the case of motion sickness, that story involves a pregnant woman who had severe allergies and hives.

EAU: mmm.

EW: You can probably tell where this is going.

EAU: Mm-hmm.

EW: So, in 1947, she had been prescribed an antihistamine, which was effective in relieving her symptoms, but she was also surprised to find it had another consequence. Her entire life, she had gotten car sick really easily, but while she was taking this drug, she found that she could ride in cars with no problem at all.

EAU: Wow. Even while pregnant.

EW: Even while pregnant. Yeah. So she told her medical advisors about this, who had her try it out against a placebo, no dice. Still got car sick. And they began to plan a larger study testing whether this drug could prevent seasickness in a group of sailors. And it worked. I mean, remarkably, remarkably Well, it was like such a clear relationship.

EAU: Yeah.

EW: It wasn't like, oh yeah, some people found really, it was like, no, the vast, vast majority,

EAU: Wow.

EW: were completely either prevented or alleviation of symptoms.

EAU: Wow.

EW: Trade name: Dramamine.

EAU: Dramamine!

EW: Dramamine.. as the 1950s closed into the 1960s space travel provided new motivation to understand the site, the physiological impact of unnatural motion on the human body. And finally, some plausible mechanisms began to crystallize, explaining both what is happening [01:05:00] and why. And you already went through both the what and the why. Uh, but I think that, yeah, it seems to come down to, our brains get overwhelmed by all these confusing and contradictory sensory inputs, and then we get nausea, pallor, cold sweats, vomiting, et cetera,

EAU: so, so interesting.

EW: I mean, like I've said a couple times now, we humans did not evolve under non self-propelled transport.

EAU: I feel like that is such an interesting part of the story, Erin. It's like that, but especially in the context of, of all animals, not all, but so many animals being susceptible under the right conditions that it really is just like we're just doing this to ourselves, but like now we can't not, right. Like you can't not go in a car or a train or a plane or a boat. Like you have to get around somehow.

EW: yeah.

EAU: It's so interesting.

EW: And so it is, yeah, like I, I think it, it is shows that we don't know, like we evolve under conditions of how to interpret the world around us, and we don't know what to do when that world moves out of our control.

EAU: Yeah. In a way that just doesn't make sense for our brains based on what our body can do. Oh, that's so interesting!

EW: And so we, we have, you know, recent advancements in our understanding of, of the physiology and underpinnings of motion sickness. And we have some different drug formulations. like you said, this is an unavoidable consequence of our technological prowess as a species,

EAU: Yeah.

EW: at least for now. Like we, we have to, this is what we are dealing with.

EAU: Yeah.

EW: And so for anyone who has experienced motion sickness or who has witnessed it firsthand, it is clearly both wretched and debilitating. Which is what the, the first quote, those, those words, I was, I read that quote to Jon and he was like. That is exactly, it is exactly it. Debilitating is the word that I would choose. And in some respects, we have come a long way in the past few decades, but in others, we're still completely at the mercy of the waves or the camel that we're riding.

EAU: Mm-hmm.

EW: So

EAU: Yeah.

EW: tell me, Erin, uh, I, I guess how, how many of us can expect to be motion sick? Do we have promising reach, research on the horizon? What's, what's going on today?

EAU: I'd love to tell you, Erin.

No, we. I mean, like I said, already all of us could get motion sick. It really just depends on if we're exposed to, to the right sort of stimulus. And we know this from looking at like different scenarios on large planes like the, the commercial airlines that most of us fly on, it's usually less than 1% of people that tend to get motion sick. Whereas in little planes, like a Cessna or a little plane, up to 25% of passengers might get sick. And even on commercial planes, while it's usually less than 1% that are getting sick overall, On a particular flight where people are getting sick, it can sometimes be up to 8% of people. So it really depends on the amount of turbulence and like what you're experiencing on that particular flight.

EW: Right.

EAU: Up to one third of people can get sick on long distance car rides. On cruises, motion sickness is the most common reason for physician consultations. More than infections, more than injuries, and

EW: What about Norovirus, Erin?

EAU: Including norovirus. So more people go to the doctor, and that's just the people who didn't already come with Dramamine and Scopalamine and have the medicines that they need so that they don't need to see the doctor. Right. And that's on huge cruise liners. On life rafts. It's like 50 to 60% of people who are going to get motion sickness on something like a life raft, especially in more, uh, what's the word? Bad seas,

EW: choppy waters? Yeah.

EAU: Choppy Waters, adverse conditions. Um, so any of us could.

EW: Yeah.

EAU: Where do we go from here? I have no idea. I did not see anything about like new medications, new treatments. There is a lot of, and maybe, maybe a lot is even a stretch, but there will be changes in who is experiencing and how people are experiencing motion sickness with an increase in the use of things like virtual reality.

EW: Mm-hmm.

EAU: some papers out there that are like, what about self-driving cars?

EW: Oh, interesting. Right?

EAU: Because in a self-driving car you are obviously not the driver and we do see that people tend to get less, motion sick if they are not just the one like driving the thing, but even if they're engaged in certain types of tasks. So like having to use your brain for certain types of tasks but not others, um, can help to reduce your susceptibility to motion sickness, which is super interesting.

EW: [01:10:00] Like, like being the car DJ or the map reader or what?

EAU: Or like, maybe not reader, 'cause then you're looking at your papers, but um, like people who had to do, I think mental arithmetic were less likely to get motion sick than people who were just supposed to think about not getting motion sick or something like that.

EW: that's weird. Okay.

EAU: Know. So anyways, there, but again, we don't really know like why, why is that? Is it just because your brain is having to focus on other things so it's not bothering to interpret these sensory discrepancies or something? Like we really have No, we don't know. We do not know. But there probably are going to be more of us that are getting sick in different situations. Right. Because of the changing ways that we do technology today versus how we used to in the past. And that's all I got for you, Erin, about motion sickness.

EW: It's, it's so interesting that there's not more about like research for either pharmaceuticals or, because like

EAU: And maybe I just missed it, so if someone's working on it, please tell me and I'll apologize. But I didn't see anything. It was hard to find recent papers in general. Most of my papers were old.

EW: I think it's, it is, it is really striking to me that like, it seems that placebo effect, which we were talking about before we started recording and

EAU: how interesting

EW: it is and we should do an episode

EAU: we should.

EW: doesn't seem to be there for motion sickness.

EAU: It can be, there's some, there's some, there's some papers. I mean, especially when you think about like some of the, there are some papers that show that things like these sea C bands or that might be a brand name, so sorry about that. But like the motion sickness bands, um, or other, and like, is that a placebo or is that actually doing something? Who knows? But some papers seem to show that there's an effect and others don't. Um, and similarly with placebos, like there's some that show that there might be an a placebo effect and others that don't really show much of a placebo effect. So it's all just, it is really, I mean, motion sickness is a really interesting, weird and debilitating condition that any of us could experience.

EW: Oh, it's, it is interesting that I, I didn't know about that, about the current research seems like historically there was not a lot of placebo effect

EAU: mm-hmm.

EW: It's because they were using lactose pills. I don't know

EAU: Maybe.

EW: But how much lactose was in the lactose pill.

EAU: Yeah. Who knows? Another day.

EW: time.

EAU: And if you wanna read more,

EW: we've got some sources. We've got a bunch. Uh, so let's see. I'm, I have a bunch, but I'm shouting out two in particular. One is that Book by Reason and Brand Motion Sickness published in 1975. And then there was a great overview of the history, like historical writings on motion sickness called, uh, by, by Huppert, et al from 2017 called a Historical View of Motion Sickness, a plague at sea and On land also with military impact.

EAU: It's very descriptive. Um, I really enjoyed actually a textbook chapter from the Handbook of Clinical Neurology. Um, I think it was chapter 27, called Motion Sickness by Golding. Uh, from 2016. Also, all of the papers, even the more recent papers, looking at the mechanisms and this idea of like, uh, sensory conflict and neuro mismatch, cite this paper from 1978, uh, by reason

EW: Oh yeah.

EAU: Was called Motion Sickness Adaptation, a Neural Mismatch Model. They all still cite that paper, like there's not been more data to show it.

EW: That's, that's the author of the book.

EAU: Oh yeah. So anyway, so that's a great paper. It's actually really great paper. Um, and then there's a bunch of other ones as well too, all about, you know, the treatment, the pathophysiology, et cetera. You can check 'em out on our website. This podcast will kill you.com. I also have some extra reading if you want, about like our vestibular system and, uh, our proprioceptive system and little, little, little fun bits like that. So check it out.

EW: Yeah.

EAU: podcast will kill you.com under the episodes tab.

EW: Uh, thank you again to Kristina for sharing your story with us.

EAU: It means so much. Yeah, thank you.

EW: Yeah.

EAU: Thank you also to blood mobile for providing the music for this episode and all of our episodes.

EW: Thank you to Lianna and Tom, and Mark and Jessica and Sabrina, and everyone else who works on the

EAU: many of you.

EW: Yeah.

EAU: Thank you.

EW: is growing ever longer.

EAU: keep probably missing people.

EW: Uh, thank you

EAU: Uh, thank you to you everyone listening and watching. Hello. thanks. We like, did you like this episode? I liked it.

EW: know, do you get motion sick? Let us know.

EAU: Do, you, we all do to some degree.

EW: we

EAU: Could have you yet,

EW: have

EAU: you need to go to space

EW: Ooh. All

EAU: to, to get motion sick?

EW: list. Thank you to our patrons also. We appreciate your support. It really means the world to us.

EAU: It does.

EW: we, love you. Thank you.

EAU: Thank You

EW: Okay. Until next time, wash your hands.

EAU: animals.