Gemma Ware: The new year often brings with it resolutions to be healthier. But what if all you have to do to improve your well-being is learn how to be more attuned to the signals of your own body? New research into a sixth sense called interoception is exploring the connection between our minds and bodies. And the hope is that it could lead to breakthroughs in mental and physical healthcare. I’m Gemma Ware and this is The Conversation Weekly, the world explained by experts.

To begin this episode, I’m joined by Vivian Lam, Associate Health and Biomedicine Editor at The Conversation based in San Francisco. Welcome, Vivian. Great to have you on the show.

Vivian Lam: Thank you.

Gemma Ware: So Vivian, we’re focusing today on how we feel and interpret the signals that our body sends us, say if we’re hungry or thirsty, and I know that this is something you’ve been thinking a lot about, and you’ve edited some stories on it too, so tell me what got you interested in it.

Vivian Lam: One of my favorite quotes is by this French surgeon, René Leriche, who said that health is a life lived in the silence of the organs. That made a lot of sense to me, because if your body isn’t screaming at you in pain or thirst or hunger, then in that absence is a sign all is well. So then the corollary to that would be wellness can be found in that, you know, hokey cliche-ish of listening to your body.

But after many, many, many therapy sessions, I realized that, actually, I often don’t listen to my body. So, I get a slight twinge in my tendon and I’d keep running on it until like I can’t even walk anymore. Or I’d skip meals because I didn’t feel hungry, even though I was, like, definitely hangry. But I think many people discount the requests their body makes of them, because it’s often seen as this unruly and irrational thing that has to be beaten into submission through willpower alone. Like, no pain, no gain, and like 10 ways to trick your body
into thinking it’s full or energetic or happy. So then health by that logic is achieved through discipline and deception.

**Gemma Ware:** That’s really a great way to put it. You can often discount the requests that your body makes of you. Hunger is a good example of this, isn’t it? It’s also an important one, because lots of areas of health are really influenced by what we eat.

**Vivian Lam:** Yeah, there’s so many factors that influence the desire and decision to eat that go beyond nutritional needs. That’s where interoception comes in. It’s also called the sixth sense, not in a paranormal way. So interoception is sensations that inform you about the internal state of your body. So, sweaty palms might mean you’re anxious and shivering might mean you’re cold. And these cues often lead you to behave in ways that satisfy those needs in order to return your body to homeostasis, which is just a stable, internal, biological state. The interoceptive signals for hunger might seem pretty straightforward, like, you know, a grumbling stomach means you’re hungry. If your gut feels like it’s about to burst, it means you’re full. And there’s more subtle cues that drive the desire to eat, like why people with iron deficiency might crave ice or a whole host of reasons why someone might crave carbs or fat-rich foods.

**Gemma Ware:** And we don’t really know much about how it really works, this internal communication, but there is actually quite a lot of new research that’s trying to find that out. Tell us more about what’s going on.

**Vivian Lam:** Yeah, we’ve mostly talked about hunger, but there’s a lot of research connecting it to many mental health conditions that are linked to impaired interoception. Like a lack of interoceptive awareness is linked to a number of eating disorders, like anorexia or binge eating, because there’s difficulty gauging appetite and satiety. But having low interoception is also linked to self-harm and suicidality. And conversely, being overly aware of certain interoceptive signals is linked to anxieties or disorders, and so on and so forth. Still, as you said, it’s a burgeoning field so researchers are working to fine-tune how they measure interoception to disentangle that kind of bi-directional relationship between interoception and psychiatric conditions. Like, which comes first? Is it that you start out with impaired interoception, and that sets the stage for the development of a mental health condition? Or is it that certain mental health conditions erode interoceptive functioning, and does one mutually inform the other? And better understanding that could perform and complement treatments.
Gemma Ware: Thanks, Vivian. We wanted to find out more about interoception. So we reached out to a leading scientist in the field here in the UK called Sarah Garfinkel. She’s a professor at the Institute of Cognitive Neuroscience at University College London. And it so happens that her office is just a few blocks away from The Conversation’s office here in London. So, I went along to meet her in person.

Sarah Garfinkel: I do have a computer here.

Gemma Ware: So, what are we going to be doing?

Sarah Garfinkel: So, you’re at rest now, so…

Gemma Ware: I haven’t just run up the stairs.

Sarah Garfinkel: You haven’t just, yeah, you haven’t just run up the stairs. So, I’m interested to see, just at rest, how accurate you are at detecting when your heart is beating.

Gemma Ware: OK. So, you’re connecting, gonna connect me up with something… on my finger?

Sarah Garfinkel: Yeah, so this is called a Pulse Oximeter, and if you look inside, can you see a little light?

Gemma Ware: Yeah, a little red light… on the end.

Sarah Garfinkel: Yeah, so this is going to help us detect when your heart is beating.

Gemma Ware: OK.

Sarah Garfinkel: I’m gonna push it just so your nail peeks through.

Gemma Ware: Yeah.

Sarah Garfinkel: If you don’t mind placing your finger on the table.

Gemma Ware: Yeah.
Sarah Garfinkel: And please don’t move it. So, the easiest task is known as a heartbeat tracking task, where what I want you to do is see if you can silently count each time your heart beats.

Gemma Ware: OK.

Sarah Garfinkel: And normally people instinctively close their eyes when they do interoception tests.

Gemma Ware: Yeah.

Sarah Garfinkel: And I find this actually really interesting because our brain oscillates between internal and external processing.

Gemma Ware: And closing your eyes helps you focus internally?

Sarah Garfinkel: Exactly, block out the world.

Gemma Ware: Mm-hmm. So, I think I probably will close my eyes.

Sarah Garfinkel: Yeah.

Gemma Ware: It’s funny because you’re thinking where am I meant to be feeling it?

Sarah Garfinkel: Oh, that’s another interesting question. Do people feel it in all different places?

Gemma Ware: Like in my finger.

Sarah Garfinkel: Yeah. So take, no, yeah, no…

Gemma Ware: No, hand on other hands…

Sarah Garfinkel: No bodily touching.

Gemma Ware: OK yeah, Not trying to touch my pulse. OK, I’m gonna… I wont.

Sarah Garfinkel: OK. So, see if you can just lock in internally to that signal. When the computer says start,
Gemma Ware: Yeah.

Sarah Garfinkel: if you can please silently count how many heartbeats you feel.

Gemma Ware: OK.

Sarah Garfinkel: And when the computer says stop, tell me how many you felt. OK?

Gemma Ware: OK.

Sarah Garfinkel: You ready?

Gemma Ware: Yeah, I’m ready.

Computer: Start!

Gemma Ware: Yeah, so it’s a strange task trying to isolate your own pulse. If you happen to have access to a pulse oximeter anytime soon, do give it a go.

Computer: Stop!

Gemma Ware: OK. 18.

Sarah Garfinkel: You know, not bad.

Gemma Ware: Really? What was it?

Sarah Garfinkel: So it was 22.

Gemma Ware: Oh, really? OK.

Sarah Garfinkel: But actually, that’s really pretty accurate.

Gemma Ware: Is it? Like, what’s the range that people have?

Sarah Garfinkel: Yeah, it’s not unusual for people to sometimes report half as many as they actually have.

Gemma Ware: OK.
Sarah Garfinkel: And I always find that strikingly fascinating. So actually you’re in a really, pretty good range.

Gemma Ware: Now that I was feeling quite proud of my above-average ability to count my own heartbeat, I thought it’d be a good time to find out what interoception actually is. I’d come to Sarah because she was part of a group of around 100 researchers who had gathered in 2016 to write a consensus definition of interoception. There was a lot of debate, but here’s what they came up with.

Sarah Garfinkel: It’s about the sensing and integrating of signals arising from the internal body across conscious and unconscious levels.

Gemma Ware: So it could be something that’s unconsciously happening, but your body is sensing it, but you don’t know that your body is sensing it.

Sarah Garfinkel: And this is one of the things that I’m so interested by. Absolutely. Because our brains are registering internal signals all the time. But we’re not aware of it most of the time. It wouldn’t be adaptive if we were constantly distracted by our beating heart, by the slow wave signal from our stomach. You don’t want conscious insight into our kidneys all the time. And actually our brains have developed a bias to be perceiving and aware of the external world or our exteroceptive senses, which dominate.

Gemma Ware: That’s interesting. So our brains are picking up on the external things, but that internal, what’s going on inside our organs, we just let that kind of be and don’t really pay much attention to it.

Sarah Garfinkel: Absolutely. And actually, if we start paying attention to it, then maybe something’s gone wrong or those signals are changed in some way.

Gemma Ware: OK. So, tell me why all this is important. You know, we all know that this is going on in our bodies. Why is it important?

Sarah Garfinkel: So first of all, it’s important for symptom perception, because if you’re trying to accurately detect what’s going on in your body, then that is important for noticing different disease states. Or you may start to develop strong beliefs about the body, like palpitations, which don’t actually map onto cardiac events.

Gemma Ware: OK, so you might imagine that you’re having heart palpitations.
Sarah Garfinkel: Yeah, I think imagination is a strong word because these people really do believe it, but because there’s this fascinating disconnect of what the body is actually doing, with people’s precision into detecting it, then you do get these sort of anomalous sensations.

Gemma Ware: Sarah says that our interoceptive sixth sense can also shape our emotions.

Sarah Garfinkel: Our emotions arise from the sensing of bodily sensations. And what makes emotion distinct from cognition, it’s the feelingness of it. And what are feelings? And I’m a traditionalist, I like to think of feelings as changes in bodily states and our perceptions of them. So, trying to understand how different clinical conditions may have differences either in the bodily signals themselves or the sensing of these changes and how that might map onto different emotion profiles. So with PTSD, it might be much more bodily activity, which interacts with the brain, to heighten fear.

Gemma Ware: My stint as Sarah’s guinea pig wasn’t finished. The next task was designed to test what’s called my sensory integration. That’s how I experience and organize the sensory information that I receive from my body and my environment.

Sarah Garfinkel: What I’m going to do is play you a series of tones.

Gemma Ware: Mm-hmm.

Sarah Garfinkel: And if you can please tell me whether you think these tones are in sync or out of sync with your heart.

Gemma Ware: Oh, interesting.

Sarah Garfinkel: And this one is so much harder because it’s actually an internal-external integration test. And if they’re out of sync, they’re only just out of sync with your heart.

Gemma Ware: OK.

Sarah Garfinkel: But most people can’t do this task at all.

Gemma Ware: OK.

Sarah Garfinkel: We can train them to make them better, but they can’t do it.
Gemma Ware: OK. Can you do it?

Sarah Garfinkel: No. I can now do it a little bit better. I’ve been doing this for a long time.

Gemma Ware: Yeah.

Sarah Garfinkel: But certainly when I started, absolutely useless.

Gemma Ware: OK.

Sarah Garfinkel: OK, so…

Gemma Ware: After a short period of calibration, Sarah told me that I was going to hear a series of beeps, and I needed to judge whether they were all in sync with the rhythm of my heart or out of sync with it.

Sarah Garfinkel: So you listen to them all and they’re all going to be in sync or they’re all going to be out of sync.

Gemma Ware: OK.

Gemma Ware: Out of sync.

Sarah Garfinkel: Well done.

Gemma Ware: Is it?

Sarah Garfinkel: It was. Was that weird?

Gemma Ware: It just didn’t feel right.

Sarah Garfinkel: It didn’t feel right. Yeah, you’re right.

Gemma Ware: I couldn’t really put a why, but it just didn’t feel right.

Sarah Garfinkel: That’s exactly right. Yeah. And often people instinctively kind of feel it but don’t necessarily know they feel it.

Gemma Ware: Yeah.
Sarah Garfinkel: So this is one of the things that I love about interoception is that we don’t necessarily have good insight. So I love the fact that you just sort of instinctively knew, but you didn’t really know.

Gemma Ware: It just felt off.

Sarah Garfinkel: Yeah. And this, I think, gets at something really fundamentally important about interoception is the sort of guiding instincts. And whereas our exteroceptive system has developed to help us navigate the outside world. So typically with vision, you know, if you are attending to something and it’s above a certain threshold, then typically, you know if you’ve seen something or you’ve felt something or you’ve heard something. There’s good, conscious insight. Whereas interoception, you have this sort of severing of insight to actual accuracy, where it might guide you, but you might not be aware it’s guiding you or know it’s guiding your confidence. Which is so interesting because people can develop beliefs about the body, which don’t necessarily coincide with what the body’s actually doing, or they might think they’re not good at reading bodily signals and then like you turn out to be actually surprisingly accurate.

Gemma Ware: I feel quite proud of myself.

Sarah Garfinkel: You should do.

Gemma Ware: In tune with my heartbeat. So this is obviously one simple test you’ve just done on your computer, but what other ways can we test interoception?

Sarah Garfinkel: So for me, interoception is a multi-dimensional construct. So there’s tests where we can look at accuracy, and then we can focus in on different organs. So this is a very simple way to do the heart. There are other more elaborate psychophysics-based ways to test accuracy to the heart. We can also look at respiration. I can get you to breathe through a big tube, and then I can hide filters at the end of the tube, but just add a tiny bit of resistance. And I can see when you notice that bit of resistance. So when the breath is just a little bit harder and I can look at your sensitivity that way. So most of them are pre-conscious. And so we can study interoception on a pre-conscious level using brain scans, using other techniques. And then we can also study people’s awareness of those signals, and individual differences in that. Why are some people more aware than others? We can also look at trait-level differences and actually how accurate you are. We’re all accurate if we’ve done exercise or if we’re scared, and then our accuracy goes up for these signals for our heart, say,
because those signals are amplified. So you get these amplifications that happen with certain situations, but then you also get these fascinating individual differences where some people are also actually very accurate also at rest where there’s no amplification to those signals.

**Gemma Ware:** Sarah explained to me that research into interoception can help scientists understand the causes of emotional conditions like the PTSD she mentioned earlier, as well as physical conditions such as non-epileptic seizures. Neurologists and psychiatrists have struggled to help patients experiencing these kinds of seizures because they don’t show up on normal tests of brain activity. So, a group of neuroscientists who were researching interoception decided to try a different test, a measure of body-brain integration called Heartbeat Evoked Potential. This allows them to see how the cortex of the brain actually processes a person’s heartbeats. Their findings were astonishing.

**Sarah Garfinkel:** You look at the signal in the brain that changes with the processing of each heartbeat. Then, the amplitude of that drops just before one of the functional seizures.

**Gemma Ware:** So your brain thinks that your heart isn’t beating in the same way?

**Sarah Garfinkel:** Yeah. Yeah, essentially something like that. There’s a reduced body-brain integration, whatever that means for the heart. The heart-brain integration is reduced. Just before functional seizures, it’s a little severing of body-brain integration that predicts the onset of the seizure. So it’s also possible that looking at body-brain integration measures gives us a new metric for understanding things. So it’s not the body alone. It’s not the brain alone. We have a new informative measure of body-brain integration, which also helps us understand symptoms.

**Gemma Ware:** Interoception research is opening another promising avenue to help with our understanding of neurodivergence.

**Sarah Garfinkel:** I do a lot of work in autism and individuals who are autistic sometimes don’t know they’re hungry, they sometimes forget to eat, or sometimes they really like a food so they just carry on eating and eating it because they’re not getting the signal that they’re full. And that can lead to problems and there, there’s a case for potentially intervening. Autistic individuals also sometimes feel really, really anxious, and some of my work with Hugo Critchley and Lisa Quadt also shows that interoceptive error could also be related to anxiety. So we actually devised a clinical trial for anxious,
autistic individuals to try and train them to be more interoceptively accurate with the hope that this would help them manage their anxiety.

**Gemma Ware:** And how do you train someone to be more interoceptively accurate?

**Sarah Garfinkel:** We’ve, so far, just done very simple protocols, but they really do seem to be effective. We do six sessions that last 30 minutes each. So, we got people just to do light exercise. Now suddenly the heart is beating stronger and faster, people are more accurate. And then we do these interoceptive tests with them, just like you did, where we got them to count their heartbeats or judge whether tones are in sync or out of sync with their heart. And then we tell them whether they’re correct or incorrect. And also they have interoceptive feedback, because their heart’s beating stronger and faster. And then we repeat this over and over again until their heart signal comes back down to baseline. But the idea is here we can just train their sensitivity to the signal and then eventually when at rest, we have shown that they then become more accurate at rest to their hearts. And at the end of that—it’s a registered published clinical trial, we were able to make individuals significantly less anxious. We haven’t published, but we’ve unblinded the follow-up data. These effects lasted after one year. But what we’re most excited by was that we pre-registered a threshold which we called recovery.

**Gemma Ware:** Recovery from anxiety is of course a bit tricky to measure. But in the study, Sarah and her colleagues found the participants had at least a 6-point drop on a 20-item scale of anxiety. This was enough to be clinically meaningful, meaning that the people taking part actually felt an improvement in their everyday lives. Using those criteria, a third of the autistic people in the study recovered from their anxiety after the interoceptive training.

**Sarah Garfinkel:** Which potentially speaks to anxiety having many causes, but maybe for some people, there’s something about the imprecision of reading the body which contributes to anxiety. And speaking to these autistic individuals afterwards, they helped us understand why it was helpful for them. So for example, one individual said that they got better at, just noticed when their heart signal started to ramp up, and it helped them then take deep breaths and take time to calm themselves down at an earlier stage, whereas before they only realized they were anxious when they were already in a high anxiety state, at which point it was much, much harder to control. So it seems to be linked to the phenomenon of autonomic control. Greater precision gives you an early indication of when you might need to help regulate yourself.
Gemma Ware: So that’s training for anxiety, going back to that hunger example. Are there ways that you can manage it? So like if you do something to a schedule, for example, is that one way of dealing with that kind of problem?

Sarah Garfinkel: Well, what was so interesting and it’s not systematically tested, but when we asked people after this clinical trial, one quote in particular, but others spoke to it as well, that interoceptive training to the heart, help them eat, drink and go to the toilet. So, we hope to systematically look at it in the future, but certainly based on their experience, it gave them more accuracy that generalized to other bodily axes as well.

Gemma Ware: Sarah and her colleagues are still conducting research in this area, including looking at what’s actually going on in the brain as interoception is happening. She hopes that their work will open up new ways of thinking about our physical and mental health.

Sarah Garfinkel: We’ve had such a brain-centric understanding of physical and mental conditions for so long, and actually the brain doesn’t work in isolation. And it’s my hope that as we understand more bodily signals in the interaction with brain, we’ll actually get new insights into different conditions, which will have profound implications for treatment. The body is much easier to treat than the brain. So it’s really exciting to think what can we do to target the body relatively easily. And I hope we see changes.

Gemma Ware: That’s it for this week’s episode of The Conversation Weekly. Thanks to Sarah Garfinkel at University College London, and to our colleague Vivian Lam at The Conversation in the US, who you heard at the top of the show. We’ll pop a link in our show notes to an article that they just edited on interoception that was recently published on our website.

This episode was written and produced by Katie Flood, with production assistance from Mend Mariwany. I’m Gemma Ware, the show’s executive producer. Sound design was by Eloise Stevens, and our theme music is by Neeta Sarl. Stephen Khan is our global executive editor, Alice Mason runs our social media and Soraya Nandy does our transcripts.

You can connect with us on Instagram, @theconversationdotcom, on X, formerly known as Twitter, @tc_audio, or email us directly at podcast@theconversation.com. Do also sign up for The Conversation’s free daily newsletter by clicking on the link in our show notes. If you like what we do, please support our podcast and The Conversation more broadly by going to donate.theconversation.com. That’s donate.theconversation.com, and please rate
and review the show wherever you listen, as it helps us reach a wider audience. Thank you so much for listening.