Yale Talk: Conversations with Peter Salovey

Episode 19: Improving Indoor Air with Award-Winning Design

**Peter Salovey:** Hello, everyone. I’m Peter Salovey, and thank you for joining me for Yale Talk. Climate change is one of the greatest challenges facing humanity. The extreme weather we’re seeing around the world is just one manifestation of this multifaceted problem. Climate change leads to biodiversity loss and endangers human health, among many other issues.

At Yale, Planetary Solutions—meaning climate change and the evolutionary response to it—is a top priority for scientific investment. It’s an area of focus across the campus, from ecology and economics to the School of the Environment and the School of Architecture.

My guest today, Phoebe Mankiewicz, is a Yale Ph.D. student who is doing cutting-edge, interdisciplinary research with an aim toward fostering healthier people and healthier ecosystems. Thank you, Phoebe, for joining me today.

**Phoebe Mankiewicz:** Thank you for having me.

**Peter Salovey:** So let’s start with the basics. Can you tell us about your research and the question you are trying to answer?

**Phoebe Mankiewicz:** Absolutely. So my research has to do with indoor environments. I’m particularly interested in indoor air and the microbial communities that cover our indoor surfaces and our skin and how that impacts our health. What my research is primarily focused on [is] using to vegetative green walls, so plant walls, to remediate indoor air quality and to inoculate these microbial environments. And there’s a lot of ways in which we’re seeing that that can benefit indoor inhabitants.

**Peter Salovey:** So these are indoor walls covered with plants?

**Phoebe Mankiewicz:** Not only covered with plants; they’re indoor walls that encompass everything about a plant—the leaves and the roots and the incredibly diverse microorganisms that inoculate their root systems.

**Peter Salovey:** And you might have one of these in a commercial space or in a residential space?

**Phoebe Mankiewicz:** Absolutely. You can have it in a commercial space, a residential space, your apartment. We usually make them modular so that we can make them as large or as small as we want.

**Peter Salovey:** Do you do actual experiments with them where spaces are randomly assigned to have plant walls and others are not? Or do you study them some other way?

**Phoebe Mankiewicz:** I’m part of the Yale Center for Ecosystems and Architecture. My background is in biology, but I work with chemists and plant eco-physiologists and soil scientists as well. We definitely use an experimental method. Methods range from laboratory experiments, really small-scale, looking at one plant in one kind of growth media under very specific conditions, to much larger scale, where we actually implement the walls, either in a building as part of a build, or experimentally as part of an office where we can take baselines before, compare the functionality of the wall, and also look at what happens to the room when we remove the wall.

**Peter Salovey:** What are you finding so far?

**Phoebe Mankiewicz:** Well, like all interdisciplinary research, it’s complicated.

**Peter Salovey:** And takes time. I know.

**Phoebe Mankiewicz:** What we’re finding so far is that the growth media you grow the plants in make a big difference and that these walls have a lot of potential. The other thing we’re finding is that air quality chemistry and microbiology is incredibly complex and coming up with really simple answers to the question, what do these walls do for us? is not as simple as you would think.

**Peter Salovey:** You know, we’re all thinking about indoor air quality, not just from an environmental point of view, climate change point of view, but also from a pandemic point of view. Right? We’re all worried about ventilation systems and the like. Does having a plant wall help with those kind of challenges? Are you less likely to have viruses in your indoor air environment if you have a plant wall?

**Phoebe Mankiewicz:** So this kind of research is ongoing. I wouldn’t want to say that our walls can remove COVID because we haven’t done those tests yet. But if we think about COVID as a particle rather than as a virus, the particle sizes that COVID falls into are removable using plant walls.

The other aspect that I’d like to bring up, though, in terms of a pandemic, is with people staying at home and being in an indoor space way over 90 percent of their day, having an indoor plant wall has really good benefits for our cognitive function. So if you think about looking at your screen or even at paper all day, this is very two-dimensional and that’s very difficult for our brains. Our brains have to work very hard to do that all day. We evolved to see things in multiple dimensions and multiple depths. And so if you think about looking up from your desk, out the window, the trees outside your window give you a visual depth of perspective that your screen doesn’t give you. And you can feel your brain relax when you look at vegetation. And what we’re finding is what’s called the biophilic effect. This is actually something that we tend to control for because our research is primarily about, how can we change air quality and what benefits does the air quality have for our health? But this is an additional benefit that vegetative green walls can give us; it’s good for our brains.

**Peter Salovey:** Is it something about the fact that you can look away from the screen and have something attractive to look at in the middle distance, sort of like looking out your window at a forest? Or is it actually something to do with the plant life itself being in your indoor space?

**Phoebe Mankiewicz:** So that’s actually two different questions. In terms of your visual field, if you think about a forest, when you’re looking at a forest, you’re not just looking at the forest as a whole, you’re looking at some leaves are closer, some leaves are farther away. Your eyes are constantly focusing and refocusing on your environment. We don’t get that in our office environments. Office environments tend to be very flat. And people who are interested in the biophilic response are finding that this refocusing at different depths is very relaxing and beneficial to the brain and has cognitive function benefits downstream as well. If you are able to focus and refocus and look at different leaves and different depths, you can come back to your work and you’re actually better at your work.

**Peter Salovey:** So it should work also if you have a nice view of a body of water and or you’re looking at the horizon or a beautiful sky with clouds and such. It’s the ability to look away from that screen every once in a while and focus on something at a different depth. Maybe a scene that’s relaxing, but also complicated enough that you’re focusing at different distances from yourself. Does that sort of describe the effect?

**Phoebe Mankiewicz:** Yes, definitely. And complexity is important. So looking at the water, refocusing on buildings in the distance, is all very beneficial. But you can do it at a much smaller scale with vegetative plant walls because you have higher complexity, you have leaves on leaves.

**Peter Salovey:** And of course, you don’t have to be able to afford waterfront property. I assume ultimately anyone could have a plant wall in their apartment or home.

**Phoebe Mankiewicz:** Absolutely. That’s the goal.

So the other aspect of your question is, what are the plants doing that we don’t necessarily measure? And this moves into the field of bioeffluents. Bioeffluents, VOCs, are produced by plants. And what we’re finding is they can have a very complex impact on our cognitive function. So VOCs have kind of become a dirty word in urban environments because anthropogenic VOCs, like formaldehyde is a common one that wafts off of wet rugs, have been correlated with everything from asthma to cancer and urban diseases, but plants produce VOCs as well. So if you think of pining is the smell of pine trees. So VOCs are a very wide category of compounds. So the short answer for the other aspect of your question is that the compounds that plants produce are looking like they have a calming effect on us.

**Peter Salovey:** This is obviously a multidisciplinary field. I’m hearing environmental science. I’m hearing architecture. I’m hearing botany. I’m hearing biochemistry, and probably more. So why did you decide to pursue this kind of work at Yale?

**Phoebe Mankiewicz:** The way that I found my way into this realm is a little bit meandering. My background is in biology. I got my undergraduate from McGill University up in Montreal, and if you would’ve asked me at that point, I would have told you I was going to go into invasive species ecology, which is very different from what I’m doing. But then my advisor and mentor, Anna Dyson, who at that point was a professor at Rensselaer Polytechnic Institute, RPI, she was looking for a student to come on to her green wall project. So I did my master’s with her at RPI in this realm. At that point, I wasn’t really thinking about going into the Ph.D. because RPI is much more engineering-heavy. But then Anna Dyson moved to Yale. And Yale, of course, has the Yale School of Forestry, which has a very long history—

**Peter Salovey:** Now called the Yale School of the Environment.

**Phoebe Mankiewicz:** Now the Yale School of the Environment. And so really what brought me to Yale was not only to continue working in this field, but to continue working in this field *with* Yale School of the Environment.

**Peter Salovey:** So I understand that your project, Pure Inhale, just won a major award for sustainable design. And the award is from the LafargeHolcim Foundation. And wondering if you could tell us a little bit more about Pure Inhale, this prize-winning idea.

**Phoebe Mankiewicz:** First of all, the award that we won was fourth prize in the LafargeHolcim Next Generation category, which is the under 30 category. My submission was most of what we talked about, which is vegetative green walls and all of the benefits that they can have on urban human health. But the twist that I put on it and a twist that we talk about at Yale CEA [Center for Ecosystems in Architecture] a lot is that even though these systems are usually, as of right now, put into high-end corporate lobbies or office spaces for companies who can afford them, really where they’re needed are environmental justice areas. So the example that I gave that’s close to my heart is: the South Bronx has one of the highest illiteracy rates in the country. My old boxing coach’s son died of asthma. There’s food deserts, and I don’t want to call the Bronx a lack of community involvement, because actually the Bronx has incredible—

**Peter Salovey:** It has a very tight community. My wife is from the South Bronx. Did you live in the South Bronx also?

**Phoebe Mankiewicz:** I didn’t live in the South Bronx. I grew up on City Island. I worked in the South Bronx as an AmeriCorps VISTA [Volunteers in Service to America]. As an AmeriCorps VISTA, I worked in primarily the Port Morris area, which is really the most southern part of the South Bronx. My focus during that time, I spent two years there, was really working with those communities and their access to the waterways. The Bronx, because of Robert Moses and a long history of really complex political aspects of New York City, the Bronx is pretty much entirely cut off from the Harlem River on the west side of the Bronx, until you get up to the sort of Riverdale area. But these environmental justice areas in the South Bronx, of course, are in New York City, one of the most famous and oldest harbors in the world, and they don’t have access to the water.

So as an AmeriCorps VISTA, I worked with the Harlem River Working Group, whose main event every year was in collaboration with Wilderness Inquiry, which is a phenomenal group that goes around to urban areas and takes urban kids for canoe rides out in their waterways. What we were doing is getting kids who had grown up in, you know, the building next to Roberto Clemente State Park and had never been in the water and got them in canoes so that they could see their house from the waterway and start to change their perspective about natural systems in their highly urbanized area.

**Peter Salovey:** Sounds great.

**Phoebe Mankiewicz:** So tying back to Pure Inhale and the LafargeHolcim win for the Next Generation prize, the twist that we put on it is, not only can vegetative systems benefit officegoers, but they can, from a grassroots perspective, benefit many aspects of these communities and environmental justice areas, including asthma rates, including food deserts, and could even work as a community nexus and an opportunity for communities to grow their own food, but also educate themselves and educate their children around plant growing.

**Peter Salovey:** How do we think the COVID pandemic has changed people’s view of the importance of this kind of work? We talked a little earlier about the saliency of good ventilation. It seems to me that a pandemic is going to create a whole new interest in indoor air pollution more generally. Let alone the environment in which you live, and the waterways around you. It just changed our consciousness a bit.

**Phoebe Mankiewicz:** Previously, in the indoor air quality arena, we’ve talked about how humans, especially in urban areas, spend 90 percent of their time indoors. That’s the sort of benchmark. I don’t think that really sunk in to your average person until the pandemic hit and suddenly you didn’t leave your house for a week because you were working there and living there and doing yoga in your living room. You are no longer leaving your apartment or your house to go to work or to go to school. And so I think not only did people suddenly realize how much time they were spending indoors, but the amount of time we were spending indoors increased. This starts to put a lot of pressure on indoor spaces to be good for us, because if they’re not good for us and we spend 98 percent of our time in these environments, they’re going to have a huge impact on our health and well-being. Of course, there’s a huge social disparity here as well. If you’re living in a house in rural Connecticut, where you are surrounded by trees and you can open all your windows and you have a beautiful scenery and good air quality, your health is going to be very different from someone in the South Bronx who was maybe ten floors up, whose windows on one side of their apartment building open into an alleyway. It’s going to look very different. You’re going to be looking at things very differently. You’re going to be breathing air that’s very different. You’re going to be sleeping very differently, according to some studies. And all of those things together can really impact your quality of life and lots of health metrics.

I think the pandemic really changed that for a lot of people. One, you’re realizing how much time you’re spending indoors and realizing that you feel better outdoors because that threshold now is much larger. And the second one is realizing that your indoor space really impacts how you feel.

**Peter Salovey:** So there’s a huge psychological component to this as well. There used to be a field—there still is a field—called environmental psychology. And my guess is it’s going to experience a kind of rejuvenation as a result of the pandemic, too.

So while we’re talking about those kinds of things, you describe your Ph.D. as “I’m doing an interdisciplinary Ph.D.” I hear public health. I hear architecture. I hear environmental studies at other levels, plant biology and chemistry and psychology, human cognition. What do you mean when you say I’m doing an interdisciplinary Ph.D.?

**Phoebe Mankiewicz:** I would say that I work in the nexus of five disciplines. I wouldn’t call myself an expert in most of those. Like I said, my background is in biology, so I’m most comfortable talking about plants and microbes. But even biology spans multiple disciplines. So the five main ones, I would say, that I work within are what’s called plant eco-physiology, which is, How do plants respond to their environment and how do plants function? Soil science, which is within the soil, what are the different soils made of, what kinds of microbes do they foster, and the interface between plant roots, microbes, and the abiotic aspects of soil. Air quality chemistry, which has to do with VOCs and how VOCs interact, at least that’s what I spend most of my time thinking about in that field. Human biometrics. Now, a lot of what I do, I don’t necessarily measure human biometrics, but thinking about human metrics of health in the context of all of these things, what happens to a human if we put a plant in a room? That kind of stuff. And last but not least is architecture. And architecture may seem like the odd one out, but is actually where I got into this. Because I did my master’s in architectural science rather than in biology, I got to work at the nexus of all of these fields. If I were to be working in a plant ecophysiology lab, I probably wouldn’t be thinking about anthropogenic VOCs and emissions in urban areas. I might have a couple citations in my introduction talking about how that’s important, but I wouldn’t necessarily get to test it. And so because I’m working with all of these fields in an architecture-based program, I get to look at them all. I don’t have to choose. And I can do that at Yale.

**Peter Salovey:** So summers are often a productive time for graduate students. People are doing field research or laboratory research, but with the pandemic, there were a lot of disruptions to that. Were your plans disrupted, and what are you working on this summer?

**Phoebe Mankiewicz:** Yes, my plans were disrupted. I was supposed to start my experiments last summer. And then the pandemic happened, and to their credit, the Yale greenhouses were mostly functional through the beginning part of the pandemic, but many of the fabrication facilities were not. And because I am not a uni-disciplinary Ph.D. student, I needed both. But now we have things up and running again, and we are beginning our experiments. Right now we’re in the midst of taking baselines in the Yale Science Building. So we are looking at air quality and microbiome diversity in three different locations in the Yale Science Building as the basis for experiments moving forward.

**Peter Salovey:** Fantastic. And what happens in subsequent years? How long are you with us here at Yale?

**Phoebe Mankiewicz:** Well, the original plan was to graduate probably mid-2022. Where I’m at now with experiments and grant- and article-writing, I’m probably looking at December 2023.

**Peter Salovey:** And that probably is a bit of a function of the pandemic as well, right?

**Phoebe Mankiewicz:** Absolutely. I am an interdisciplinary Ph.D. student that relies on an interdisciplinary cohort of people. This is another major difference between an interdisciplinary Ph.D. and a more traditional Ph.D., in that I’m not by myself in a laboratory doing my own experiments. I am part of a cohort and part of a collaboration network that includes many people at Yale and also people at NYU and other universities. And those relationships are invaluable in this kind of work, you can’t do it without them.

**Peter Salovey:** This kind of interdisciplinary work, cutting-edge work, it requires a village of experts in various fields to work with you as a team, it sounds like.

**Phoebe Mankiewicz:** Absolutely.

**Peter Salovey:** Well, this has been fascinating, and I’m so thrilled that you could spend a little time with us describing this project. And it makes me want to have an indoor bio-wall in my office. I do have a windowsill of orchids in my home that I try to cultivate. It’s not something that I do with the passion of someone who really is into orchids, but I do try to make them bloom a few more times than once and have had some success with them.

Well, there’s so much exciting work happening across Yale’s campus related to climate change and sustainability, and it’s wonderful to hear from you, Phoebe, about your research and experiences and to know some of the most innovative scholars are working on these important issues here at Yale.

So thank you for taking time to speak with me and best of luck in your research!

**Phoebe Mankiewicz:** Thank you so much.

**Peter Salovey:** To learn more about Yale’s leadership in climate change, research, and education, please visit the Planetary Solutions Project website at planetarysolutions.yale.edu. That’s one word: Planetarysolutions.yale.edu.

To friends and members of the Yale community, thank you for joining me for Yale Talk. Until our next conversation, best wishes and take care.