

Sound Expertise Season 3:14 –

The Science of Silence with Chaz Firestone

Transcribed by Andrew Dell'Antonio

Chaz Firestone 00:00

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[Music] 00:20

Will Robin 00:42

Welcome back to Sound Expertise. I'm your host Will Robin. And this is a podcast where I talk to my fellow music scholars about their research, and why it matters. Except today, I won't be talking to a musicologist, music theorist, or ethnomusicologist. Instead, my guest is Chaz Firestone, Assistant Professor of Psychological and Brain Sciences, and director of the Hopkins Perception and Mind Laboratory at Johns Hopkins. It's been my intent for a while to talk to some more sciency folks in or outside of music studies, partly because I'm not a sciency person myself and find a lot of it a little hard to understand, and partly because there's a lot of really interesting work happening right now at the intersection of STEM and music scholarship. I'd encourage you to check out the new edited volume, the Science Music Borderlands, for more on that. And then in July, I started reading these intriguing headlines about the sound of silence, a very John Cage-y research study into how we perceive silence, undertaken by a team of cognitive scientists. And as it turns out, one of the co-authors of this study is Chaz, who happens to be a longtime friend of my wife, Emily. And so we were chatting at my son Ira's birthday party about his work a few weeks back, and I realized it was a perfect opportunity to have him on the podcast. So here's Dr. Firestone and me talking about his work on perception, and this fascinating new cognitive study on silence.

[Music] 02:11

Will Robin 02:22

So let's start with a basic question, which is that I know you, if not your work, super well. And I was always under the impression that you dealt with stuff around sight and perception. So I was kind of surprised to see you suddenly getting famous for talking about sound and silence. So can you talk a little bit about the background behind your interest in exploring this issue of the perception of silence?

Chaz Firestone 02:46

Absolutely. So our interest in this question about the perception of silence actually traces back to an earlier and maybe more foundational question about the kinds of properties that we can perceive in the first place. So one of the most basic questions that we ask about our minds in both psychology and the philosophy of perception is — what kinds of things can we perceive? What is the function of our

perceptual system? And maybe more particularly, what's the function of each of our senses? And this is a question that goes back a very long way. So you can find discussion as far back as Aristotle, or Bishop Barkley going through our different senses, and essentially asking what each one of them is about, fundamentally. So vision, what's that about? Well, vision has to do with the light reaching our eyes. Touch, what's that about? Well, touch has to do with our body coming into contact with objects and substances. And so hearing, what's that about? Well, intuitively, hearing is about sound. We can hear a beep, we can hear someone's voice, we can hear a piece of music, maybe we can hear properties of those sounds. So we can hear the pitch of the beep, we can hear the hoarseness in someone's voice, maybe we can hear the loudness of the piece of music. And more generally, the notion that what we hear is sound, and properties of sound, just seems kind of obvious. If you ask someone on the street, what do we hear? A good answer would be — sound. That's what we hear. And so silence ends up being really interesting. Because whatever silence is, and there's a real question about how to characterize silence, whatever it is, it's not a sound. It's the absence of sound. That's just what it is for there to be silence. And yet, it often feels like we can hear silence. So we talk about hearing a pause in a conversation. Maybe we can hear the gap between thunderclaps in the middle of a storm, we can hear the hush after a musical performance. And so silence ends up being an interesting test case, because if it isn't really a sound, and yet it turns out that we can hear it, then evidently hearing is about more than just sound. And then we would have a new answer to the question that has been with us for a very long time, which is this question — What do we hear?

Will Robin 04:56

That's interesting. Reading the study and also some of your other work, it was interesting for me as someone who doesn't think about visual perception, and I don't think about necessarily the question of perception in sound, I think about sound in other ways, but that the experiments you're doing have these clear analogues that I guess you started with in visual perception. Can you talk a little bit about how you got interested more broadly in this question of perception, and also how you're drawn to this intersection of science and philosophy, which is, I think, what makes your work more readable to me than a lot of other scientific work that I don't really know what to do with.

Chaz Firestone 05:36

It turns out that to be a perception researcher, you have to be a mini expert in a bunch of different things in a way that I just find personally very exciting. So you have... I'm in a psychology department, so I have to know about... I have to study people and how their minds work. But you have to be a bit of designer, a graphic designer, you make visual stimuli, you're a bit of a computer programmer, when you make experiments. Sometimes you get to moonlight as a theorist or a philosopher, or at least hang out with people who are good at those things. And perception is just such a meaningful and salient part of our experience in the world. In a way, there's nothing more familiar to you than your own perceptual experience. It's the thing you do more than anything else. You spend a decent amount of your time talking, you spend a decent amount of your time eating, sleeping, thinking, but proceeding, hearing and seeing the world around you, you do that all the time. As long as you're awake, and your eyes are open, you're seeing the world around you, your ears — you don't even need to open them, you're hearing all the time. And what's really interesting, as a perception scientist, is that despite the fact that perception is just so personal, and so present and so salient and so much a part of your experience as you go through the world, you don't as the person who's perceiving actually have much insight into how

your own perceptual system works. It kind of just happens to you, you just open your eyes, and then boom, you have this amazing visual experience. Some music plays, and wow, you hear it. Under the hood, your brain is doing all sorts of very sophisticated processing to make that possible for you. And then it hides all the things it did from you, you don't get to scrutinize all the computations that your brain is doing to create this sort of magic of perceptual experience. And so, getting to study this seemingly very subjective and personal, but also very salient and present process, as if it were a scientific object, is something that I find very exciting. If you grew up being interested in both the science and the humanities, you liked chemistry and physics, I liked those topics, but I liked English and Philosophy, the idea that you get to study the mind, which you might not have thought of as being in the same sort of category as an electron, or a chemical bond, but you get to study them like those things, it's just a very exciting thing to do. And that's kind of what we do in my home field of cognitive science, and then more specifically, my area of perception research.

Will Robin 08:05

So before we talk about the specifics of the silence experiment, what are some of the visual perception experiments that your lab has done? And what discoveries have they made that set up this one focused more on sound and silence?

Chaz Firestone 08:22

Well, a question that my lab has been interested in for a long time is this question that I led with earlier, what kinds of properties can be perceived in the first place? So if you were to open a perception textbook, or you took a course in college on perception, you would find chapters in that textbook for the perception of color, for the perception of shape, for the perception of size and distance. And in my field, there's been a sort of trend recently, or a new idea that we should think of perception as being a bit broader than just what we would call basic visual properties. So there's a thought, now over the last several decades, that actually we should think of something like face perception as being just as much a part of perception as the perception of color or size, that actually you have dedicated mechanisms in your brain specialized for the processing of other people's faces. Similarly, there's some work in my lab that looks at our ability to see that two things can combine into another thing, like when you are completing a jigsaw puzzle, and you can see — aha, this piece can go with that piece to make something new, or the ability to perceive properties around you that you might think of as corresponding to the physics of the scene around you. So maybe you see a water bottle balancing precariously on a table, you get this sense that sort of grips you — Oh, no, it's going to fall! Or — actually it looks fairly stable. And my lab has been interested in that question too, what kinds of processes in your mind give you that impression of stability or instability. And more recently, a question we've been interested in, that has a sort of counterpart in our study on silence, is the perception of absence. So normally we think of perception as telling us what's there in the world, I can see people, I can see objects, I can see the clouds, I can see a flower. But there are some experiences we have, where it seems that we're aware of nothing being there, or of something missing. So imagine that you were working at a cafe, and you left your laptop on a table, and then went to the restroom, you came back, and — oh, gosh, your laptop is gone. It's been stolen, you just stare at a table. And what you're looking at is an empty table. You've seen tables like that before all the time. But this table feels different, because it should have a laptop on it, and it doesn't. Maybe you return to your bicycle, and it's missing its front wheel, you have this very salient experience of the absence of the wheel. And absence

perception is a really interesting case study. Because, like I say, we normally think of perception as telling us what's there. We normally think in the case of visual perception, that light hits our eyes from objects in the world. And then we see those objects. But in the case of absence, there's no light hitting my eye from the missing laptop. There's no light hitting my eye from the missing bicycle wheel. And so the perception of absence ends up being a really interesting test case for various other ideas we have about perception, and then our interest in silence in some way stems from that. So if silences are auditory absences, then they're a nice counterpart to the visual absences that we've been studying recently.

Will Robin 11:21

So what's the specifics behind the silence study? How did you conceive of the different ways that you were going to test this question?

Chaz Firestone 11:33

So what we have to do in this study was, in some ways, reconceptualize the question that motivated it. So the question that we start with is, do we really hear silence, or do we merely recognize or judge or cognitively understand silence? And it's worth dwelling a bit on that distinction, because there's some ways to talk about it, where it can get kind of technical, but there's other ways to talk about it, where it might be a distinction we respect in other contexts. So let's go back to vision for a second, suppose that you were looking at a painting, and you're appreciating various aspects of the painting, you can see the color of the painting, and you can see how far away it is. But here's something you can't see in the painting, you might not think that you can see its political significance. Or you might not be able to see its nation of origin. Those are things you can infer when you're looking at a painting, but they're not literally things you can perceive with your eyes. But then maybe there are some cases that sort of live in the middle. So do you see the beauty of the painting? Well, you might think that's a little more sophisticated than just its color and how far away it is. But it's a little more grounded in visual properties, than its political significance. So there's an open question, and people debate it in the philosophy of perception and in psychology too, can we really perceive beauty? Or do we just see the painting and then make some judgments about how beautiful it is? And then we could ask a similar question about silence. The options would be: we literally hear silence, our auditory system includes silence as the kinds of things that it processes, or what happens during silence is we just don't hear anything. And then we conclude that there must be some silence around us. So I can think about silence in other contexts and other visual absences. I can think about the fact that there's probably no elephants in the room with Will right now. It's not because I'm seeing the lack of them. It's just that I'm reasoning about the lack of elephants. So the question about silence is going to be, do we really perceive silence? Or do we just think about it? Do we just fail to hear when it's silent, and then just make some judgments about it. And then what we have to do to turn that into a science experiment is find a way to study that the way that a cognitive scientist would. And so what we do, and I say we — I have two collaborators in this project, a graduate student who's doing an interdisciplinary PhD in philosophy and psychology, his name is Raja Go. And also a colleague of mine, who is a philosopher of cognitive science named Ian Phillips, who's actually done some scholarship on the perception of silence from a philosophical perspective. And together, what we did is we slightly reformulated the question — do we really perceive silence? As the question — Does our auditory system treat silences

the way that it treats sounds? And I can say more about that question. Does that make sense as a slightly different formulation?

Will Robin 14:28

That does. Yeah, say more about that question. That's obviously the specific research question out of these kinds of brain processes that you're coming to.

Chaz Firestone 14:41

Exactly. So it would be a bit hubristic of us to think that just with some experiments, we could resolve this millennia old question about whether we perceive silence, but if we change the question a little bit, but still respect its origins, maybe we can make some progress on it. So now let's dwell with our new question. Does the auditory system treat silences, the way that it treats sounds? Well, in order to study that, what we're going to do is leverage something that we know about how the auditory system treats sounds. And one thing that happens in the perception of sound is that there are some really interesting auditory illusions that can arise. So there are cases where you can play people some sounds, and if you play them in just the right way, people will hear them differently than they really are. I can give you an example. And this happens to be one of the examples that we've studied. It turns out that there's an interesting auditory illusion, it's called the one is more illusion, it was discovered by a researcher named Stanley Yousef. And it's the finding that if you play someone one long, continuous sound, it will sound longer than two short, discrete sounds, even if those two short discrete sounds add up to the same duration as the one long sound from start to finish. And I can actually play you that sound, that illusion right now, if you'd like to hear it.

Will Robin 15:59

Please!

Chaz Firestone 15:59

So what we're going to do now is hear the one is more illusion. And here's what's going to happen. You're going to hear a voice say "One", and then you're going to hear some beeps. And then you're going to hear a voice say "Two," and then you're going to hear one long beep. And your job, if you were a subject in this experiment, would just be to say, which sequence of events sounded longer, one or two? So why don't we hear the one is more illusion and see how it sounds to us.

Unidentified Speaker 16:27

One, Two

Chaz Firestone 16:36

So most people when they hear that soundtrack...

Will Robin 16:40

Two definitely sounds longer to me, even though you set it up so that I was biased, but it still did sound longer, I think.

Chaz Firestone 16:50

Good. And if you feel that way, and you are a subject in our experiment, you behave like other people, too. So when we run this experiment, when the original researchers run it, and when we run it, too, we find that people judge the one long tone as longer than the two short tones, even though that's not actually the case. So that's a pretty interesting illusion, and you could be interested in it for its own sake. And in fact, some people are, they want to know — why does this illusion arise? And what explains it? And what else does it tell us about the mind? But our interest in this illusion is actually more that it's a nice tool for us. So what we can do is we can say — if there's these interesting illusions where your brain treats one long sound as longer than two short sounds, even when they're not, what if we replaced the sounds with moments of silence? So what if we could create a situation where we can play you one long moment of silence, or two short moments of silence, and see whether you judge the one long moment of silence as longer than the two short moments of silence? If we could do that, that would be some evidence that your auditory system treats silences as, an appropriate kind of input, as in fact, even the same kind of input as a sound.

Will Robin 18:03

Could you actually set that up for us without telling us what we should do and then I can see what I say?

Chaz Firestone 18:09

Absolutely. So the way that we're going to do this is, whereas in the original “one is more” illusion, we're hanging out in some silence, and then some beeps arise, what we're going to do in this case, is we're going to transport you to another location, it's going to be a busy restaurant. And in our experiments, people wear headphones, they adjusted the volume to try to get immersed in this auditory soundscape. And then you're going to hear some moments of silence injected into, this auditory stream. And so it's going to be the same as before, you're going to hear a voice say “one, and then you're going to hear some moments of silence, and then you're going to hear the voice say “two,” And then you're going to hear some other silence. And your job is going to be to judge which thing sounds longer.

Will Robin 18:56

So the question of whether the first set of silences or the second set of silences is longer, when put together.

Chaz Firestone 19:03

That's right. So let's listen to that.

Unidentified Speaker 19:04

One. Two.

Will Robin 19:31

I think I heard the second one longer?

Chaz Firestone 19:34

Great. You could be a subject in all of our future experiments.

Will Robin 19:39

Really? Shouldn't you not say — great, shouldn't it be unbiased? Shouldn't you just say — okay, or something? [laughs]

Chaz Firestone 19:44

Well, it was unbiased until you told me what you heard and then it was — Aha! Our hypothesis was right. So, we have some reason to think that silence really is perceived, but the literature that's extant on this question from the philosophy of perception has mostly relied on the methods that are proprietary to philosophy, things like thought experiments, and even just reflecting on the phenomenology of silence, which is a totally legitimate way to make progress on questions like this, but it's a little bit removed from empirical data. And so what happens here, though, is we have some evidence now, from these illusions, that your brain is treating these moments of silence the way that it's treating sounds. And the evidence, again, is that you get the same phenomena arising with silence as you get with sounds, you heard one moment of silence as longer than two moments of silence, just like you heard one long sound as longer than two short sounds.

Will Robin 20:41

How many illusions did you have? And how many people did you try them out with, to conclude that this was the case?

Chaz Firestone 20:51

We run our experiments over the internet. And that actually lets us run a lot of people in them. So this is a really interesting trend in psychology research right now, it used to be that if you wanted to study how someone saw or heard the world around them, you'd have to bring them into your lab and show them things and play them things. And those people were often college undergraduates, and it was hard to get a lot of them, or at least if you wanted a lot of them, you'd have to use a whole semester. But now, it's possible to make experiments on little web pages that you deliver to people's home computers. And these people can be all over the country or the world, they can be native speakers of English or not. They can be from all kinds of cultures, they can have maybe more diverse backgrounds, or political beliefs, or tax brackets as it were, than college students. And you can also run a lot of them. So if the whole internet is available to you, then you can run 100 people in your experiment in one day, if you want. And so on the question of who we ran, and how many people, we actually ran 1000 people in our experiments, and that lets us be quite confident in what we discover in the end, if we discover anything, because that's quite an adequate sample for a study like this. And then your other question was about other illusions that we studied. In this paper, we ran seven experiments, and they came from three different illusions. So what we did is we took three illusions that were already in the literature, and that had been shown to arise from sounds. And we made silence versions of all three of them. And in all three cases, the same thing kept happening, we kept finding the same illusions with silences as we found with sounds. And that's exactly what you would expect if your brain treats silences the way that it treats sounds, which sort of gives us an affirmative answer to our research question. It suggests that we really do perceive silence, in the sense that our brains think that silence is just as good a kind of input for auditory processing as a sound.

Will Robin 22:51

So what do you do with that information? What can you draw from the fact that I heard those — we just did two little experiments together, one with sound where I heard the second sound cumulatively longer than the first two individually, and then the exact same thing happened with silence?

Chaz Firestone 23:14

Well, maybe one way to think about the answer to that question is to think about other things that could have happened when I played you those sounds. So here's what could have happened. It might have been that we found this kind of fun illusion with sounds. But then when I played you a silence version, nothing particularly interesting happened. Maybe you said — Oh, I don't know they sound the same. Were another thing that could have happened is that the illusion would reverse. So it could be that actually in the silence case, to short silence to sounds longer than one long silence, that would suggest that silence is kind of the opposite of sound, which would be really different than that, what we were after. Another thing that was possible, is maybe the illusion would be really powerful with sound, but then pretty weak with silence. And that's actually not what happened either. So that's hard for us to see, sitting here listening to it together, but it is something we can measure in the data. And one thing we found in our experiments was that it's not just that you get the same kind of illusion with silences as with sound, you get the same thing. The magnitude of the effects is the same, the percentage of subjects who show the effects is the same. In other words, the strength of the illusion is the same with silences as with sounds. And so what we keep finding is this sort of conspicuous similarity between the way that your mind is treating silence and the way that it's treating sounds. And so that is the basis of our inference that we're really hearing silence, every way we check. Every experiment we do. Every way we look at the data, we keep finding that silences are treated the same as sounds. And so that's how we say — Aha, there really is some evidence that you hear silence, just like you hear sounds. It's not just that your ears are working okay and then you just see you say to yourself — hmm, I guess there's some silence around me.

Will Robin 25:01

Where do you go from here in terms of ... Are you going to continue to investigate sound and silence? Are you going to what other kinds of conclusions can you draw out of this experiment or use to build other experiments? Or was this just a one off, and then you're going to go back to seeing stuff?

Chaz Firestone 25:18

Well, there's a few different directions that I think are really exciting. So the first is that there's definitely other experiments that we can do on silence. Another question we might have, for example, is whether silence can have properties of its own. So when you think about sounds, for example, sounds can be loud, and they can be quiet, can silences be loud and quiet? That's a question we might want to know. Maybe silences inherit some of their properties from the sounds that go away, you might think that when a loud sound turns off, you get a loud silence. Or maybe when a quiet sound turns off, you get a quiet silence. And maybe we can come up with some ways to measure that. We can also look at whether silences can be distracting. So intuitively, if in the middle of our conversation, we heard a siren in the background or a loud bang, it would capture our attention, and we would get distracted by it. And we would say — Oh, what's that over there? That was a loud sound over there. Well, what happens if there's a big silence that happens in the middle of our conversation? Let's say that while we're speaking, you have an air conditioner going in the background, and then suddenly, it turns off, and

you're confronted by the silence and you go — ah! Maybe it can grab you the same way that a sound can grab you.

Will Robin 26:32

Yeah, you need to check out Wandelweiver. That's all about what happens when a tone suddenly drops out, then how you actually feel that.

Chaz Firestone 26:43

Okay, good. Yeah. So it would be great to discover some psychological signature of these phenomena that have been present in other spaces for a long time. And you've just given an example. Another question, though, that we can ask is whether we can use some of these techniques to go back and study visual absences. So this idea of substituting absences for presences, substituting silences for sounds in this case, is actually a general research strategy that you could use. So if we want to understand phenomena like returning to your seat, and discovering that your laptop was missing, returning to your bicycle, and discovering that its front wheel is missing, we could take the same substitution approach. So we could ask whether visual absences show similar signatures of visual processing as normal objects. And in fact, we have some studies like that underway as well. But I think the lesson or follow up that's in some ways the most interesting to us as a collaboration, and to me as well, is just the example of taking a question from philosophy and trying to do some science on it. And one thing that I'm excited about in this project, is that science does have a history of trespassing on the humanities, and even trying to replace questions that come from the humanities with scientific questions in a way that we're not trying to do here. So it's possible that we're doing it by accident, and without realizing it. But I do have a philosopher as a collaborator. And we think of ourselves as really respecting the humanistic tradition that this question about silence comes from. And it's really adding something to our project. So if you were to talk to an auditory psychologist and say — Hey, I just read this paper on the perception of silence. Tell me all about the psychological literature on silence, and the debate about whether we really hear it, that psychologist might actually tell you — that's not really a question that actually lives here in auditory science, because this is a question that really came from the philosophy of perception. And so it's a really nice example of a really major contribution from a humanistic tradition to a scientific tradition. And the question comes preloaded with lots of distinctions that scientists weren't really making before. And so we in our project really benefit from its origins in the humanities. But then we also make a contribution of our own, which is we're collecting some data. And in fact, many of the philosophers who work on this question have already written to us to say — Oh, wow, this really does help, maybe not decide the issue, but it's very relevant empirical data that informs the philosophical literature that was already very robust on this question.

Will Robin 29:35

Yeah, I was curious about that. Obviously, if you're getting a question from philosophy, you're answering it in the sciences empirically, then what does your philosopher collaborator do when he goes to the philosophy conference and says — I have the data, we have the answer, we have an answer.

Chaz Firestone 29:52

The answer I think so far has been something like what you just gestured at. There is a feeling that we have, if not quite answered, really made some progress on a question that has been with us for a very

long time. And we've gotten some really nice messages from philosophers that work on this question that say things like — wow, how can I be involved in a collaboration like this? What else are you doing next? And that's just a really exciting thing for me. I personally, as I mentioned earlier, have spent some time floating between the sciences and the humanities. I was a philosophy major in college, I did a PhD in cognitive psychology, but I hung out in the philosophy department a lot. And I've always been a bit of a wannabe in that way. But being a wannabe philosopher and being a philosopher are really different. And there's a lot of scientists who want to wax poetic about all sorts of philosophical questions, and I try not to be that person. But getting to work closely with my philosophy colleagues on this question has been really edifying, and really getting to feel like we're making a contribution. And like I say, respecting the tradition it comes from is something that's really important to us.

Will Robin 31:05

What are you working on next in your lab, in terms of either these questions or different questions? Do you have a specific study underway? Are you still basking in this latest one? [laughs]

Chaz Firestone 31:14

you know, there's always something going on. So one of the privileges of running a research lab is that you have lots of different projects going on at the same time. So there are a number of different students who are doing their PhD in my lab, and they all have really different interests. Some of them are interested in consciousness, some of them are interested in silence like this. Some of them are interested in how we understand the actions of other people. And so there's a lot of different questions that are arising in these various domains. But it is true that the philosophy of perception looms large in most of these questions. So in fact, our lab has another collaboration with the same philosopher, Ian Phillips, but with a different student, that is about our ability to perceive the world around us as it relates to this really interesting phenomenon called inattention blindness. So, it's possible that you've seen a video of a gorilla that you fail to notice. I wonder if you've seen this before. This is a...

Will Robin 32:18

I've seen a video of a gorilla that I failed to notice. This is not the bear who's not a bear in China, right? That's a different thing?

Chaz Firestone 32:28

No, it's not that. So. I wanted to say it in a way that wouldn't ruin it. But I sort of have already ruined it.

Will Robin 32:35

Spoiler alert. Okay,

Chaz Firestone 32:37

But I'm going to bet that some of your listeners have seen something like this. There's a famous video that's been ... at this point in its history, there's hundreds of millions of views of it, where you have the job to look... you look at a video of some people playing a makeshift basketball game. And in the middle of the video, a gorilla, it's really a man in a gorilla suit struts across the middle of the frame, and does a little dance and then runs away. And there's this really amazing finding that people don't notice that this happened, because they're not paying attention to it.

Will Robin 33:10

[laughs] Is this something your lab did?

Chaz Firestone 33:14

No, no, this is one of psychology's greatest exports. High school students see it sometimes. And there's a book about it called the Invisible Gorilla. And what's really amazing about it is that it seems to show that we're not always aware of as much as we seem to be. But in our lab, we have some work coming out, that suggests that we actually, even when it doesn't feel like we're aware of some of these things, we might actually be aware of them in ways that people who have studied this in the past just haven't realized. So it turns out, for example, that if instead of asking somebody — did you notice a gorilla dancing in front of you, you instead say — hey, something pretty crazy just happened, I don't know if you noticed, can you tell me the color of the thing that happened or the direction that it happened? Or what side of the display in front of you it was? And they'll say — Oh, well, now that I think of it... Was there something on the right side? And it turns out that people can actually get the right answer to some of those questions, even if they'll tell you that they didn't notice the big salient event that occurred. And this comes from the philosophy of perception as well.

Will Robin 33:14

Cool. Thank you so much for speaking to me. This is super fascinating.

Chaz Firestone 34:20

Thank you, Will, for having me.

[Music] 34:21

Will Robin 34:28

Many thanks to Charles Firestone for that great conversation. You can read more about his work and try out some more of the auditory illusions that his lab developed over on our website, soundexpertise.org. As always, our inbox is open. If you have questions or thoughts about the show, email us at soundexpertise00@gmail.com, or tag me on twitter or instagram @seatedovation. Thank you to D. Edward Davis for his production work. You can check out his music on SoundCloud at [warm silence](https://www.soundcloud.com/warm-silence). I'm grateful to Andrew Dell'Antonio for transcribing our episodes to make them more accessible. And — next week on Sound expertise, our season three finale.

Unidentified Speaker 35:08

I'm a music theorist, I'm a Russianist, and I've published a lot of stuff and obviously, I've never gotten hate like that by publishing something in Russian music theory. And all of a sudden, it became right wing hate, a part of this culture of hate that we have now in our country.

[Music] 35:58

