Hear Here Podcast – Season 1, Episode 4: Dr. Lina Reiss

Hello and welcome to the Hear Here podcast. I'm your host, Karen Gordon, I'm an audiologist and senior scientist at the hospital for Sick Children in Toronto, Canada, and a professor at the University of Toronto. Our goal with these discussions is to explore new ideas that may help people use devices like cochlear implants to hear. Transcripts of these discussions are available alongside the recordings.

[Music]

Karen Gordon

Okay! Welcome to this edition of the Hear Here podcast, I am joined by my team members here; Blake Papsin and Sharon Cushing. So welcome to you both.

Sharon Cushing

Thanks Karen.

Blake Papsin

Thank you.

Karen Gordon

Awesome! So, I know we're really eager for listeners to hear from Dr. Lina Reiss. She's a professor at Oregon Health and Science University.

She has a severe to profound hearing loss, she's had it all of her life and I think the listeners are gonna get a treat 'cause she discusses her research in hearing loss and how her experience as a person living with hearing loss shaped her journey: scientific and personal. She was so open about the challenges she faced um, as well as all the successes she's had.

So, Lina started her academic life at Princeton University where she studied mechanical engineering and from what she says, there few other students who were deaf and definitely very few women of colour who were deaf there. So you're going to hear how, um, she joined a community by engaging with other students who were deaf: both oral and those who were part of a more capital D signing Deaf community. She used listservs in the early days of the Internet to do that.

Sharon Cushing

I think it reminds us how far we've come in terms of, you know, our capacity to connect with humans. It's much easier to make those kinds of connections these days, so it really speaks to her resilience and-and desire to do it via a listserv.

[Music]

Karen Gordon

Welcome Dr. Lina Reiss you were uh an engineer undergraduate at Princeton and then, um, I want to know how you went from there to, um, a scientific career in hearing research.

Lina Reiss

Well that's a pretty long story. I'll try to give you a short version. I always wanted to do science from a very young age. I should mention that I'm also hearing impaired and I don't know if that's something that's going to be obvious to the listeners here, and I grew up with that hearing loss and hearing aids all my life.

And um, so I went to college I, uh, you know, went from major to major and I was not sure what I wanted to do, And, um, I joined the deaf listserv. It was my first time interacting with so many deaf people, deaf and hard of hearing people because I grew up in the mainstream and so it's very interesting for me, and, but it's also an exposure to a different culture and they were very against oral deafness.

Karen Gordon

How did that make you feel?

Lina Reiss

Well, I thought it was very interesting to see those different perspectives, and one of them was Tilak Ratnanather, he introduced himself.

Karen Gordon

Tilak Ratnanather, he's an associate research professor at Johns Hopkins University now. So, they met all those years ago and both continue to do auditory work.

Lina Reiss

He was a postdoc at the time, at Johns Hopkins University. And he invited me to do a summer internship at Johns Hopkins and he arranged one for me with Dr. Eric Young, in that lab. And that was the first exposure I had to any type of hearing research. And, I absolutely loved it, I just loved the combination of biology with engineering, learning about hearing and speech perception and the auditory nerve and it was so exciting! And so, I went back again the next summer and then I ended up applying for the PhD program in biomedical engineering there and working in Eric Young's lab.

Karen Gordon

And as somebody with hearing loss, were you surprised, um, that you didn't know everything there was to know about hearing already?

Lin a Reiss

That's kind of interesting. Nobody's asked me that question before.

Karen Gordon

It's a big jump to want to do a PhD so tell me a little bit about that part of the journey.

Lina Reiss

Both of my parents had PhD's and um, you know, originally, I thought I would go work in industry like my father did at Bell labs, back when Bell Labs was still alive. And um so I thought, well, you know this sounds like the way to do it, you know, to do science, you probably need to get a PhD.

[Music]

Karen Gordon

So I found it really interesting that Lina always thought she would go into science, uh, yeah, she says her parents, um, were so supportive of her. They really put all the effort in that many parents do to help her acquire that language and they are both academics themselves, and so it wasn't such a stretch for her to think that she would be, um, in science as well.

Blake Papsin

Half of our team is, uh, people who have some sort of hearing loss in their family or in family members. how else would you be exposed to hearing research unless you're exposed to it?

Karen Gordon

For us to have researchers with that lived experience is just so important because, um, they're, they're the ones who really know what questions to ask and, uh, how to ask them, maybe in a different way.

Sharon Cushing

You know, Blake, I, I'm sure it's reasonable for me to, to mention, you know, that you do have hearing loss and, and wear hearing aids.

Blake Papsin

Parents and families, um, opt to go for implants far more regularly when I suggest it, than when you guys suggest it 'cause they look at me and they see that I'm sort of normal, at least the children think that, the parents don't.

Karen Gordon

Lina actually chose to begin her um PhD studies in something that was very specific, studying, you know, um, the responses in the cochlear nucleus.

[Music]

Karen Gordon

Amazing! Okay, so then tell me how you decided on the area of interest, uh, that you wanted to study.

Lina Reiss

Now, um, you know, through the summer internship, I, you know, really enjoyed working with Dr. Young and with his lab, and I was fascinated by the complexity of the auditory circuitry, even at the level of the cochlear nucleus, uh, however, after doing that research for 5-6 years, even though the circuitry was fascinating, I, um, didn't see the immediate clinical relevance and I wanted more of a connection. What-what-what did I want to do for the next 30 years, of my life?

I already knew that with cochlear implants, there’s always a difficulty with speech in noise, and that was the difficulty that I had, even with hearing aids, mainly with speech in noise. I ended up going to Iowa and

doing my postdoc with Chris Turner working with human subjects. I really enjoyed working with patients because I could connect with them, with my hearing loss.

Karen Gordon

One of her first experiences after her PhD was going to the University of Iowa, where they were studying the hybrid implant, uh, and at the time it was really new, it was a really interesting idea of implanting people with hearing loss but who had some degree of residual hearing, mostly in the low frequencies and they were trying to do it safely by giving a shorter cochlear implant array.

Lina Reiss.

To explain the concept of the hybrid cochlear implant - it is a short version, or it was, a short version of the regular cochlear implant and it was designed to be implanted atraumatically into just the high frequency region of the cochlea and therefore, preserve the low frequency residual hearing, if that was usable. And so, it was targeted for people with high frequency hearing loss. However, if they didn't have good local nerve survival in the high frequency region, they might not do well.

So, the goal was to measure the pitch perception through the implant by pitch matching the electrode induced pitch with the acoustic hearing in the other ear. So initial experiments were interesting and promising but then over time, the correlation got worse. That got us thinking that maybe experience and plasticity was changing the pitch, so no longer reflecting the actual (cochlear) location of stimulation. And so, then we compared early pitch perception data and did find that there was change over time.

[Music]

Sharon Cushing

It, you know, it sounds like such a wonderful thing to do, right? Use what you've got that works well and then supplement what isn't working.

Karen Gordon

Her idea was that people who had better pitch matching in the high frequencies or high pitches uh between the, um, non-implanted ear and that implant ear with the shorter electrode array were going to do better. What I found really interesting is that finding over time became weaker and weaker. She had to think about this negative result - what did it really mean when her hypothesis wasn't supported over time.

Blake Papsin

We don't know the underlying e-e-etiology and what the um pathophysiology is locally and that's what makes some... But then again, it might just be cognitive ability, the-the codification of language and the codification of sound is a cognitive process.

Karen Gordon

I mean that is what-what we learn is even if we're talking about pitch, which you would think starts in the cochlea, it's gotta be a cochlear problem and you gotta match it by cochlear matching, what the finding is telling us is that, well, the brain will and the person will adapt to make that pitch work.

Blake Papsin

That's right.

Karen Gordon

And, and that's what was happening here is that, you know, the implant wasn't moving around, it was the brain pulling, um, information toward where it needed to be to make it fit.

Blake Papsin

Right, and none of it is natural and none of it is the way it was designed because the natural auditory system has an efferent system that actually fine tunes and searches the environment for what it wants to hear.

[Music]

Karen Gordon

Something that's really important that we've learned um from your work is that just because we stimulate from one part of the cochlea doesn't mean we can necessarily predict uh what someone's going to actually hear uh in-in terms of the pitch. I want to hear, um, how you've taken those ideas of plasticity into what you're doing now?

Lina Reiss

So, uh I've shifted over from uh, studies of pitch plasticity. So we've started to look at those in people with what we call bimodal cochlear implants. So those are people who are using cochlear implant, a regular cochlear implant in one ear with a hearing aid in the other, not in the same ear like the hybrid. And we didn't find as much plasticity in those cases.

We decided to start looking at, well, maybe there's something else different about bimodal processing than within ear processing, and maybe there's greater tolerance for pitch mismatches that might arise across ears than within ears, and so those - from there we started looking at binaural fusion and binaural fusion tolerances for pitch or frequency differences across the ears. And in those experiments, we found that people with hearing loss, with implants, tended to have really broad tolerance for pitch differences across ears.

Karen Gordon

Yeah, just-just to be clear when you're talking about fusion. Um, you're talking about the inability to tell that there's two different pitches, is that what you mean?

Lina Reiss

The combination of multiple stimuli into one. So, for example, just looking at music, you can have 2 tones that are an octave apart and you'll hear one sound and one chord. But, um, you know, in the special case

of people with hearing loss, you can be looking at people with different hearing devices or mismatches across the ears and you can be presenting completely different or very different stimuli that are not at musical intervals, and they might be fusing them into one sound. There's a lot of variation among people with hearing loss. So, some of them will be able to easily separate sounds and others who fuse everything together.

We want to still have some segregation ability to separate different voices, in the complex listening situations and speech in noise situations and we don't want to be fusing all those voices together. What we want is to only fuse the matched stimuli together, the ones that should be paired together and then separate out the ones that shouldn't be, uhm, matched together.

I think one of the important findings has been that this abnormally broad fusion is associated with more difficulty in separating out voices in background noise.

Karen Gordon

So, we've been looking at fusion as where things match and they come together, but she's looking at matching where things are so fuzzy in each ear that they come together in too broad a way.

Blake Papsin

It doesn't make any sense to me at all that the cochlear implant would be programmed in any way related to the one on the contralateral ear, since they're going to co-to-to-to cortical structures that subtend them that have different desires.

So, it always makes, I always say, why don't you do one with, with different, you know, speeds and frequencies and stuff like that why don't you just do different um, you know sampling rates in the two sides, that would make more sense to me than trying to match the two ears.

[Music]

Karen Gordon

All right, so I thought the next part of this uh discussion with Lina was just so fascinating because she recently I mean really recently became a bimodal user herself. She got a cochlear implant and she was really open about uh that that experience and how it happened.

[Music]

Karen Gordon

So, let's get a little bit more personal, um, in terms of your own experience.

Lina Reiss

Well that's a very long story as well and um I'll try to abbreviate that. So um, I think most of you uh who know me, will know that I have a severe to profound hearing loss and have been deaf from a very early age. And uh I was one of those kids that was lucky to benefit from early intervention, at a speech program, the summer speech school in New Jersey. And at at the time, back in the 1970s, I, uh, at the time, they didn't have behind the ear hearing aids, they had these hearing aids that were on the back. And I had two of those one on each ear, but luckily I learned to speak and listen and I was enrolled in the mainstream and then they developed the behind the ear hearing aids at that time.

So yes, for the last 40 plus years I have been a bilateral hearing aid user and I was happy to stay that way, and I felt like I was doing fine with one on one conversations as long as it was in a quiet room or a small group conversation. You know, with lip reading I would do fine. However, there are a few things that happened in the last two years that changed my mind. Flying back from a 4 flight trip to Brazil and landing at the airport, I had trouble walking straight and I felt like my vision was lagging my sense of balance and it was very disorienting. It went away after a month. Then I flew again to the ARO meeting in Baltimore, and then I was fine there. But then after flying back and landing in Seattle, I had trouble again walking in the airport. But this time it was in two dimensions, in the vertical and in the , um, horizonal dimension. And so, my husband or anybody with a low pitched voice would be talking and the room would spin or I'd be walking outside and there would be a machine that I couldn't even hear with my hearing aids and I would get dizzy. Something related to flying perhaps.

So I went in for vestibular testing and got a CT scan and, you know, I was still really freaked out because you know vestibular disorders are really quite disruptive for those of you who have experienced them. So when the CT scan came back the radiologist said, she said, I think we may have found the cause of your hearing loss, you have something called an enlarged vestibular aqueduct. So I underwent about six months of vestibular rehabilitation and was able to recover vestibular functional balance, adapt to my reduced vestibular function.

I was considering a cochlear implant by that time because well, if I'm getting a sound induced vertigo from that bad ear, the left ear, the cochlear implant would be a good way around that. Then I wouldn't have to have a mechanical sounds amplified by the hearing aid going through the ear.

[Music]

Karen Gordon

OK, so I found it really fascinating that uh Lina talked about the etiology of her, uh, hearing loss being associated with her experience of getting off a plane, and, and having uh those-those feelings of dizziness and unsteadiness not able to walk, um, maybe you can explain that for us a little bit more.

Sharon Cushing

You know, when I hear a story like that, you know, it automatically makes you think of, you know, an enlarged vestibular aqueduct or some kind of third, what we call third window, where in addition to, the, you know, the oval window and the round window, you know you have some other enlarged opening and-

and in her it you know it was a large vestibular aqueduct and it creates a fragility in the ear both from the hearing perspective but also from the vestibular perspective.

And so many individuals with this will experience acute onset vertigo, um at different periods, sometimes related to a decrease in hearing but sometimes independent of it, and so we know that you know the pressurization during flight, while it's pretty good, you know, is a risk factor, head injuries a risk factor. I never recommend that my patients with, with EVA don't fly or don't do sports or anything like that, but um, you know, because it's idiosyncratic, but certainly that fragility uh of the vestibular system is there, and-and it's the one form of hearing loss where they actually do get dizzy.

In particular, EVA or children with CMV can present with acute onset of-of dizziness and then imbalance. A lot of other kids, they don't actually get dizzy, but they have really terrible, you know, balance skills so they walk late-they have trouble riding a bike and it's-it's a pretty common and I think under, reported or appreciated um association with hearing loss.

Karen Gordon

Yeah, and as you point out, the cause of the hearing loss, whether it's a change in the structure of the cochlea, including this enlarged vestibular aqueduct, um, or a viral infection like cytomegalovirus or CMV. Um, This is a, something that many people who grew up with hearing loss and may not even know what, their, the reason or the etiology of the deafness is and, and do you think we're changing that, now?

Sharon Cushing

I think, I think there's different ways to think about it, so you know, often times you know as an implant surgeon, I would say I don't really need to know, um, the solution is a hearing aid or an implant, and that's the conversation we often have with families is that it's not going to change what we do, but it is going to change what we know.

I've certainly walked into a room, you know, a decade after the hearing diagnosis, or the implants and given a diagnosis of etiology and it means something, um, you know, moms tend to blame themselves and I think it can lift that guilt, so I think there's value in the knowing.

I think that again we're coming into an era of medicine and research where you know we're looking at specialized solutions where it's going to matter what your etiology is. So perhaps how we treat your hearing loss is going to depend on the knowing, and I think that's going to move things in a way that we haven't seen.

Karen Gordon

I think it's also really important for what we're going to do for you going forward. So, you know this idea that, you know, you could have one degree of hearing loss for most of your life and then all of a sudden that it could change. I think that was so powerful in Lina's, um, discussion, she just didn't know that was even a possibility, and so it makes me also think of the universal screening for CMV that we're doing here in our province that you know tries to address that part at least for that that particular etiology.

Sharon Cushing

Yeah, I think we're getting better at coupling both the hearing diagnosis and the etiology. We've got a ways to go, but I think you know gene therapy and things like that are also going to just move that diagnostic part along.

Karen Gordon

Yeah, the future is going to be really interesting,

Sharon Cushing

For sure.

[Music]

Karen Gordon

you start to see this deterioration in your left ear and with the vestibular effects it started to make sense to see about a cochlear implant.

So, you've got a cochlear implant in your left ear?

Lina Reiss

I'd seen the cochlear implant surgeries being done and I've done the implant with animals. I just didn't like the idea of having my head drilled into and so that was another reason why I was hesitant to get the implant.

[Music]

Karen Gordon

Even somebody who knew all about the devices and how they fit and was still nervous to you know...

Blake Papsin

Have somebody used power tools in their, uh, head beside all the important nerves? Can't imagine why. Just this morning, I was in a meeting and I had really bad tinnitus in, in my bad ear and I said, oh boy, please come back 'cause I don't think I even would, you know, volunteer for that. I really don't want to, so I understand. It came back by the way.

Karen Gordon

We're sensitive to, you know, the- that decision to, to go towards surgery, 'cause it is, it is a big one and it and, um, it was a big one for Lina.

Lina Reiss

Once I made the decision, you know I was ready to go and um it was, it actually ended up being scheduled for April and that was right when the pandemic was getting into full, you know, full swing. And so, they cancelled the surgery because they said, oh, we have to reserve the hospitals for the patients. And then they reopened uh partially in May so I was able to get my implant just a month later. Still in the middle of the pandemic, so they had masks and I brought clear masks for my surgeon and the nurses so I could understand them and that helped a lot. You know, I just went to sleep and woke up and I said what happened: “oh - they did the surgery”.

Karen Gordon

What kinds of things do you think you expected and um you know met your expectations and what were the things that were new and you didn't expect?

Lina Reiss

So every experience is different and individual and one thing that was very surprising for me early on, and I had never heard it before from our patients, was that perhaps because I had been deaf a long time, the highest frequency electrodes, they didn't sound like sound. They sounded like the absence of sound. Kind of like even you look at a light, bright light too long and then you get that afterimage? That's what it sounded like, the afterimage, something maybe the brain had not been stimulated in that region for a long time. And then it changed over time and later on became more noise-like which I also was not expecting. So my apical electrodes sounded like tones and beeps. But my basal electrodes sounded like (tsch tsch) - not like tones. I don't know if I understood speech as quickly as other people did. So you probably know that the post- lingually deaf people when they get the implant, they get a large improvement within the first few months. You know, for me it probably took more like 6 to 9 months, but then over time and I did some speech rehab as well, and over time I gradually started to recognize the voices. It's sounded very robotic and mechanical and noise-like in the beginning and then now the voices sound like voices.

[Music]

Sharon Cushing

So the incredible lived experience.

Karen Gordon

I think it's been about a year now that she has um been using an implant and she's really happy with it. She's definitely combining that hearing aid in one ear and the implant and the other. She shared that it was really wonderful to be able to share these experiences with the people she works with and to also help them understand how best to communicate with her.

[Music]

Karen Gordon

When you're trying to do a very challenging job, directing a-a laboratory and being a primary investigator and doing research, I want to hear about how, how you manage everything together.

Lina Reiss

So you know, I never thought I would be a director of a laboratory when I was, uh, you know, growing up. But Peter Steiger was the first person that I met who was deaf and was a professor. So maybe I can be a professor.

Karen Gordon

[Laughs] Well, you definitely are, and you're such a well known wonderful researcher. How does your lab work?

Lina Reiss

I just ended up you know, picking the best qualified people, but you know they did have to, you know either speak clearly or learn how to speak up and speak clearly.

So thinking some more about leading the lab, the hearing loss was not the only aspect. It was also learning how to lead the lab as a woman with the right balance and temperament. And what ended up working best for me was not leading the way that my male mentors did but observing and channeling successful women PIs in the field, like Carolyn Brown who I met when I was a postdoc at the University of Iowa and Ruth Litovsky, who I met later on and collaborated with on our grant and observing their leadership styles and how they mentored their students.

Karen Gordon

I really want to thank you for sharing your experiences as uh a wonderful researcher and also your personal experiences with cochlear implants. Um, it's just been so much fun to learn from you on this podcast, so thanks so much for doing it, Lina.

Lina Reiss

Ya, it's been a pleasure to talk with you, Karen, thank you for inviting me.

Karen Gordon

I was, um, really, really happy to uh have had this discussion with Lina and thanks to you both for getting into some of the interesting parts of that discussion.

Sharon Cushing

It's, it's amazing to hear you know about her also from behind the scenes, it uh makes me respect her work all the more.

[Music]

You can catch other episodes of the Hear Here podcast, there’s a link on our website, search Archie’s Cochlear Implant Lab Sickkids Research Institute, or wherever you get your podcasts.

The Hear Here podcast is put together by me, Doctor Karen Gordon, with my colleagues at the hospital for Sick Children in Toronto, Canada, Doctors Blake Papsin and Sharon Cushing with a tremendous production

and advisory team Sofia Olaizola, Rachel Bedder, and Maria Khan. Our wonderful Hear Here podcast music was composed and performed by Doctor Blake Papsin.