**Paul:** Friends. Lend me your engineers. Welcome back once again. My name is Paul. I'm here with Kamryn.

**Kamryn:** Hello, Paul.

**Paul:** Hi, Kamryn. Thank you, everyone, for checking in this week for a very special episode. This was actually almost our last episode.

**Kamryn:** Yeah, we almost had an incident. Well, we did have an incident almost. It was almost disaster.

**Kamryn:** But that's a better…

**Paul:** We'll get into that in just a minute. Today on the show, we have a very special, interesting experimental podcast. We actually took our podcast into the brain lab where Dr. Helen Huang was being interviewed by the Knightly News UCF. Knightly News. Nightly with a K, not NBC.

**Kamryn:** Yeah. Lester Holtz was not there.

**Paul:** No, Lester Holt did not make the trip for the local Nicholson School of Communications. But we're hoping eventually to get to that in the future. I think that's where we're heading. So Dr. Huang was being interviewed, so we thought we do sort of like an Inception, where it's a show within a show. So we recorded the audio well, yes, we recorded the audio of her being interviewed by someone else.

**Kamryn:** Yes.

**Paul:** So it's a little different. But actually it made for an interesting show. We got over an hour of footage and we were able to turn that into a show, which is what you are going to hear today. So without further ado, here is the very exciting, brave show within a show. Show within a show within a show.

**Paul:** So how do you feel after your first interview on camera?

**Helen Huang:** It was nice to be able to talk to a person versus looking into the camera, even though every once in a while I looked into the camera because that's what I had to do previously. So then I was like, no, just like a crystal. It'll be easier that way. So little baby steps, right?

**Paul:** Sure.

**Helen Huang:** It wasn't too bad. They seem very welcoming.

**Reporter:** Thank you. Thank you.

**Helen Huang:** So right now they're going to prepare the EEG cap. We're just going to put one strip in just for the sake of demonstration purposes.

**Student in lab:** Oh, do you want to get the tag?

**Reporter:** I've actually done this in another lab.

**Helen Huang: Yeah**, because there's other labs here at UCF that they use EEG or they use EMG or they have motion capture. Nobody else has a treadmill like this, but there's definitely nobody else who's, like, integrating all these things together.

**Reporter:** My picture is good, then? Yes. Okay.

**Helen Huang:** So we have a wet system, which means that we have to put some gel. And the gel acts as a bridge between the electrode tip, recording electrode tip, and the scalp. You hear electrode and people are like, ‘Are you zapping my brain?’ I'm not. Other people are, but I'm not. We're just trying to record your brain activity. So you have to put a little bit of gel in each well, and then they'll place the electrodes, and we have these little tiny electrodes. This is part of an active system active, meaning that there's a little amplifier that's really close to where we're recording the signal from, and that gives you a better signal to noise ratio.

**Reporter:** Imagine how much shorter it'll be without digitizing.

**Helen Huang:** There's another part to our preparation for our actual research, which is we have a system to digitize the location of all the electrodes on someone's head because everybody's head is a slightly different shape, which means that the electrodes will be located in slightly different places. And then part of what we're doing is we use these algorithms to try to find where in the brain the electroactivity is originating from, and we can get a better localization. Like we can identify the brain areas more accurately if we get more subject-specific information. Instead of using, like, a template for everybody, just everybody's brain is a little bit different. So something we're adding that we haven't actually started yet is we'll be getting subject-specific MRIs, so magnetic resonance images. Sorry. And we're getting that from the Orlando Health Radiology group. They're going to help us get scans of everybody's heads, everybody's brains. So then I'll have subject- specific MRIs as well. People probably think that's pretty cool, too.

**Kamryn:** That sounds really cool.

**Helen Huang:** It's just a lot more work for us in terms of analyzing all the data because now it's like, oh, now we have something subject specific. And you have to set up your code to record the specific to align it all. And using a template is way faster, but not as accurate. We want to do the most advanced techniques, which usually also require more work. Correct. Really fortunate that the university and the department gave me the resources to be able to build this lab and be able to do all these things at the same time, because as other people said, ‘Oh, your lab must be pretty expensive.’ It's relatively expensive. I think I did a pretty good job setting it up for not being excessively expensive. Equipment is expensive in general.

**Reporter:** Did you have an idea of the type of equipment that you wanted to purchase?

**Helen Huang:** Yeah, for my previous position, I came from a very well-funded lab where I did my Ph.D. And I was a research scientist. My advisor was very successful getting funding, and we kind of had all the, I say toys, but a lot of different techniques and equipment available to us. And so, of course, I want to build a lab just as impressive, but with a lot less money until I get more funding myself.

**Reporter:** And the wires you’re currently connecting now, those are the ones that they're going to record from the brain?

**Helen Huang:** Yeah.

**Reporter:** Okay.

**Helen Huang:** So that's for the EEG system. So this is a 128-channel system. So there's 128 electrodes that we would normally prep on a person. As you can imagine, doing anything 128 times just takes time. So you're like, ‘Oh, it doesn't seem like it would take that long to put in some gel and then place electrode,’ but then you're just like, ‘Okay, on time 128. You're just like, ‘Okay, this is taking longer than I thought’.

**Reporter:** How long does it usually take to set up a subject completely?

**Helen Huang:** Once we are able to do it smoothly, they should be able to do everything from putting the markers on the person, putting all the EMG on the muscles, prepping the cap, and digitizing the EEG electro locations. You should do that in, like, an hour to an hour and let's say 15 minutes. They don't believe me at this time because they haven't been able to do it yet, but they will, because in my previous lab, like I said, I came from a very well-funded lab, he had 256-channel cap, so just imagine twice as many. And we are able to prep someone in, like, an hour and 15 minutes as well because we usually have multiple people. So, like, here we have two people. We might have three people prepping participants at any time. Today they're doing a whole bodying marker set.

**Student in lab:** The first time we did it with Alejandro and Kevin, it was amazing to see the whole body on the yeah.

**Helen Huang:** Yeah. So since I'm mostly looking at, like we usually just do a lower limb marker. We just you just see the simulation of the legs, and I actually have not seen the whole body. Pretty fun marker set before, so this is new for me. This is what I mean. The students are the ones who do most of the work, right? Professors. We write the proposals to get the money so we can support the student. So hopefully we can keep them happy, do good research, take them to conferences. Like, Sayed and I well, actually, Sayed, Jen and I were leaving on Friday to go to a conference.

**Reporter:** Where are you all headed? Washington, DC.

**Helen Huang:** For the Society for a Neuroscience Meeting. It is a gigantic meeting. Yeah. There's about probably, like, 35,000 people. It's crazy. So everybody's like, ‘Oh, it seems so big,’ and it is gigantic, but then it's kind of, like, really small because you end up just hanging out with other people who do your research, so then it doesn't seem so gigantic. And what's nice is, because it is so large, you get to see a lot of people that you may not otherwise see. So that's fun.

**Sayed:** Okay. Can you just close your eyes? These are like they're called alpha waves.

**Helen Huang:** So when she closes her eyes, we can see you around, like, a 10 Hz wave on those eyes, and then it goes away when she opens her eyes.

**Reporter:** So when she blinks, does it go several times?

**Helen Huang:** Yeah, you can try blinking. Since these electrodes are on the back of her head, we may not see them as well. So take some blinks.

**Reporter**: Yeah, you see them on yeah.

**Helen Huang:** And then she clenches her jaw. So when she clenches her jaw, we just get large signal and that's from the electrical activity generated by your muscles. Should we put her up on the treadmill?

**Sayed:** Yeah. Can you check also?

**Helen Huang:** Oh, you want to check the EMG? Okay, so then

**Reporter:** Can I stand up?

**Sayed:** Sure. Okay.

**Helen Huang**: We used to put the equipment into a backpack and have people sort of carry the equipment. And then I was like, ‘Oh, my mother would probably not appreciate that.’ So then I was like, ‘Okay, we should come with a different system.’

**Reporter:** She had great students. Right?

**Helen Huang:** So this is the EMG. So this is the electromagraphy, the EMG. So you can see when she goes up on her toes, we get the muscle activity from the muscles on the back, like people, like the calf muscles as people can know them as. And then when she pulls her toes up, we get the muscle activity from the muscle in the front responsible for pulling up your toes.

**Sayed:** So we are good.

**Helen Huang:** All right, we're good. So we're going to put her on the treadmill, then create this whole body motion capture that I've never seen before in my lab. Seen it before, just not in my lab. They're treating me to something new today..

**Helen Huang:** So we had to come up with this whole sort of, like, setup so that we can try to get the best data. Oh, okay, new addition. You didn't see this before.

**Paul:** Can you explain what's happening right now?

**Helen Huang:** So we're going to move to a new method of collecting the data where we use two different systems. So we're going to have one system that records the electrical signals on the scalp from the brain. But we're also going to have another system that records signals from a reference layer. So that would just be the noise and the movement artifact. But it requires having two independent systems, which means twice as much equipment, which means nobody wants to carry all that. So we had to come up with a different way. So right now I had them install essentially like a little system where we can hoist the bag over a person. So now they're not having to carry the weight of the equipment. So that's what Jinfeng is preparing right now. And then we have a little tie down like you might see on a boat over by the window. And we have a cable, so we just hoist it up.

**Paul:** So it's like in theater where they raise up the sandbags.

**Helen Huang:** I guess. I didn't know they do that in the theater. I don't know anything about theater.

**Paul:** You just talked about last time, Shakespeare, right?

**Helen Huang:** Yeah, but that was me being in a class listening to a lot of opera on CDs at the really cool music library.

**Paul:** Speaking of music, use sandbags to raise.

**Kamryn:** And forward the curtains.

**Paul:** I know. I just said that.

**Helen Huang:** I didn't know that. I know.

**Paul:** It means you assume. Yes. Everybody learns on this show.

**Kamryn:** I've seen a theater once or twice.

**Paul:** I've seen a theater.

**Kamryn:** I've seen one.

**Paul:** I'm a proper gentleman. I go to the theater.

**Helen Huang:** There's the safety harness that we discussed in the previous podcast.

**Paul:** I know we promised that Kamryn would be hooked to this, but we'll have to save that for a later show.

**Helen Huang:** He didn't seem super excited, actually.

**Kamryn:** About what? I was super excited.

**Paul:** You ruined it, Kamryn. You weren't excited.

**Kamryn:** Was I ruined it because I wasn't excited enough? No, I would be super excited and thrilled.

**Helen Huang:** Well, we will have a lot of studies, upcoming studies.

**Kamryn:** Just let me know.

**Helen Huang:** Like, it's all on my board.

**Kamryn:** I see over there.

**Helen Huang:** Projects that are funded on the left, projects that I would like to propose on the right and on the left. That's over 100 subjects we need to collect. So a lot of data collections are in the students future. We have one lot of data will be generated. So much data that they could not use their laptop because it will crash their laptop. And then they'll be mad at me. You're like, ‘I can't do anything on my laptop.’

**Paul:** So currently our subject is on top of the treadmill, being hooked in to all the apparatus for safety. And then once everybody is ready, what will happen next?

**Helen Huang:** We have to create the model in the motion capture system. And then they'll start the treadmill and have her walk. And if we just keep all the systems running, you'll be able to see all the data being collected. And then there's my stepper back there that doesn't get as much love, but like I said, was actually the novel part of my proposal. And that is my Ph.D. project. My advisor, Dan Ferris. I always say Dan Ferris because I usually just call him Dan. And then I'm like, ‘Oh, wait. Should probably say, like, Dr. Ferris.’ He let me take it with me here. So I'm very fortunate that he allowed me to just take it. And I've been able to just keep using it for research. So that was really helpful for him to let me take.

**Paul:** Thanks, Dan.

**Helen Huang:** Yes, thanks.

**Paul:** Thanks, Dr. Ferris.

**Helen Huang:** I got my…you're just trying to cover the electrodes in the back. So how many markers should we see?

**Seyed:** 39.

**Helen Huang:** I see 38. Which ones are we missing.

**Seyed** No, we have that. 39. Or maybe this one.

**Helen Huang:** Yeah, it's one of the ones in the back. I had a lot of fun setting up my lab, actually. It was a challenge. It was like, ‘Hey, here's how much money I have. How much should I spend? Like, how much of a risk taker am I?’ Because the riskiness is obviously the more that I spent up front, that means that I would have to get funding sooner so that I could continue doing my activities. So I took a risk on my ability to get funding, and it sort of paid off.

**Seyed:** Would you like to stand in T position. Can you stand in T position?

**Helen Huang:** We’re still missing a marker. Did you place 39 markers? You know, the one you can't see is the one on the…this one like, right in the back. Turn this one. You should have one right there. Turn around. Turn around. That one because you're covering it.

**Seyed:** Okay. Yeah.

**Helen Huang:** So, like, you need to put it on.

**Reporter:** My hair tie is on the table.

**Helen Huang:** Like, I needed a lab space that had a high ceiling, so they had to actually raise this little pocket here for me. So that's up to ten foot, nine inches high.

**Paul:** Did your neighbors upstairs lose 10 feet of their office?

**Helen Huang:** No, because it's a drop ceiling, so there's still stuff above. And I wanted to be on the ground floor, and I wanted to have access to a parking lot. Because if I'm testing older adults, then I don't want them to have to walk half a mile to get to the lab, or I don't want to have to rent out the golf cart to go get them in the rain. Okay. There you go.

**Seyed:** Now there's 39 standstill in T position, and I create a skeleton on three, two, one. Okay, remove one. Yeah. Would you like to march in place?

**Helen Huang:** Wait, she has marching point

**Seyed:** And you can stop. Okay, I think it was go back. Okay, you're fine now.

**Helen Huang:** So now you can see on the screen there's a simulation of her body. So as she moves, like she's waving, then we see the little body avatar, I guess, also wave.

**Paul:** I love that ride. You like Animal Kingdom? Have you been on that yet?

**Helen Huang:** No, I have not been to Disney World since I got here. Should I go?

**Paul:** It's pretty cool.

**Helen Huang:** Okay.

**Reporter:** What we were doing when we first did this, we were, like, doing the Tekken running stance. **Helen Huang:** That's what a lot of participants who've never seen it before do. They're like, ‘Oh, my God, that's me.’ And they start dancing and just goofing around. They're like, that's so cool. It's actually kind of fun. Like, people have never seen any of this when we put it on them, and then they see when they contract their muscle, we get the signal on the screen, they're just like, ‘Oh, that's so cool.’ I hope they have fun when they come. Right? You know? Jinfeng is setting up the treadmill. Like I said, it's not like your typical treadmill at the gym where you just have a few buttons. There's like a whole program that's involved with getting the treadmill to run and operate safely.

**Paul:** There's a large red button in front of him. Is that some sort of kill switch?

**Helen Huang:** That is, yes. An operator panel that allows us to stop the treadmill in case anything might happen. There's also some safety mechanisms on the treadmill itself. There's, like, sensors, so they refer to it as a light gate, which is basically like an infrared sensor that when you block it, right, it breaks the connection. So then it will be like, ‘Okay, someone must have fallen so it'll stop.’ So there's three of those on the treadmill, and the operator has the ability to stop the treadmill if we need to. Suddenly there's a safety harness in case people fall. There's the handrails. I think one of the things that maybe is the most disorienting thing about it is you can see it's elevated off the ground, so it's like 20 inches above the ground. So you're not used to that. Right. Your treadmills at the gym are not going to be that high off the ground. That was another reason to raise the ceiling, because otherwise you can imagine, like, your head is like, right next to the ceiling. You'd be like, ‘Oh, this is not normal.’

**Seyed:** Yeah, you so what can we do first?

**Helen Huang:** I don't know. What do you guys want to see? What would be fun? What can you show us? What can we show them, maybe? Well, I don't think I want to show the perturbations, because then people, if they have an idea of what they might experience, then you might have a form of plan ahead of time. But we can show, like, incline and decline and just the treadmill going side to side just to show that we can do that. And then everybody always is like, ‘Wait, you can walk if one belt is going faster than the other?’ I'm like yes. So people like to see that too. Oh, yeah, we could do one foot going forward and one foot going backwards. People are just like, start with the simple yeah, just start with simple no, probably. Okay. Yeah. As long as we're not moving the treadmill. Are we? Because if she puts her camera there, I don't want it to move.

**Seyed:** And then they like, Why? They pitch where it would move.

**Helen Huang:** But for now, just leave it level.

**Seyed:** If you want to do that, like…

**Helen Huang:** Let us know so that she can move the camera.

**Seyed:** All right, working with 1 meter/second speed, start treadmill on three, two, one.

**Helen Huang:** See, on the screen, we're capturing her movements, her body movements, and then if you look on this screen over here, you can see her muscle activity and then the brain waves. So this is like the movement artifact that we're talking about. So there's like this little spike that is really more related to her foot contacting the ground versus getting a signal from her brain. And you can imagine it gets worse the faster you walk, right? So a lot of people who do this sort of research, they just have the participants walk very slowly, because if you walk really slowly, then you don't have the artifact, but then you can make the argument, well, is that really walking? But then they say, oh, we're looking at people with stroke, and they walk really slowly.

**Seyed:** Do you want to…?

**Helen Huang:** Okay, so what are we doing now? We're going to have one belt go faster than the other, and before that.

**Seyed:** I need to stop first. Stop the treadmill on three, two, one, stop again.

**Helen Huang:** So I guess set it so that one belt is at, like, half a meter and the other one's at 1.5. The traditional split-belt paradigm. And we'll see how fast Amy walks. So this is part of adaptation. So you can imagine at first, she'll be very asymmetric, and then as she gets used to it, it will look like she's walking more symmetrically.

**Jinfeng:** Let's see if Amy can split bout working with left bow speed .5, right bow speed 1.5. And start on three, two, one.

**Helen Huang:** It looks like they're going the same speed. No, there it is. Amy's like, ‘No, that's something like whoa.’ Yeah, big difference. Some people say it's like skateboarding, but yeah, so right now, she's still getting used to it. So you would have people walk for five minutes or something, and by the end of the five minutes, it would look like they're walking relatively symmetrically. And people are using this sort of paradigm for rehabilitation for individuals with stroke.

**Paul:** And that's where everything went wrong. No, actually, that's where one SD card ended, and it went to the next one. And remember, there's a great, big, beautiful tomorrow shining at the end of every day, and tomorrow is just a dream a way. Yay. Yay. All right, have a good week, everybody. We'll see you next week on Lend Me Your Engineers.