S1 00:03 [music] Welcome to the Sports Medicine Podcast, brought to you by the Sydney and J.L. Huffines Institute for Sports Medicine and Human Performance in the Department of Health and Kinesiology at Texas A&M University. At the Huffines Institute, we're always working to facilitate, apply, and bring you the most up-to-date coverage of the wide world that is sports medicine and human performance, all in a language you can understand and share with your friends. And now, here's our host, the director of the Huffines Institute, Dr. Tim Lightfoot.

S2 00:33 Hello, and welcome to the weekly edition of the podcast from the Huffines Institute for Sports Medicine and Human Performance. I'm your host, Tim Lightfoot, and I'm so grateful that you took the time to download us and you're listening today. Today is the next podcast in our series about stories behind studies where we talk about scientific studies that have been published and what makes those memorable to the people that actually did it. So this is our next podcast in the stories behind the studies series where we are having the people that come in that do the science tell you what makes this science memorable. So many times, there is a story behind each of these studies, that when you look at the study it's pretty black and white as to what we did, the methods we used, what we found, the interpretation of that, but often there's a story hiding behind that study, and that's what this series is about. Today I'm really pleased to have Dr. John Buchanan with us. Welcome back to the podcast, John.

S3 01:29 Thank you, Tim.

S2 01:30 John, we'll remind the audience. John has been on the podcast before. If you've been a loyal listener, you'll know that he was on our 47th podcast back on November the 4th, 2011, as a matter of fact. Dr. Buchanan is a full professor here at Texas A&M. His general research area is motor control. He basically studies how we balance and move through space. He's got 55 publications, so he's got lots of choices about what his memorable study is. And so, John, again, thank you for coming back on the podcast.

S3 02:03 You're welcome, Tim.

S2 02:04 And so we're just going to start off with a real simple question. What was your most memorable study you ever did?

S3 02:10 Well, the study I'm going to relate is the third study I did.

S2 02:14 The third study. Okay.

S3 02:15 The third study. And I was actually still a graduate student when I did it. And the reason it was memorable to me is because I couldn't believe it required so much work [laughter] to actually complete an experiment. The first two I did were fairly simple. But this one, I actually had to engineer a device that allowed people to move their forearm and wrist in rhythmic ways, but the device had to have a break on it, and it had to have some pulleys on it because people had to rotate their forearm from supine to prone and back as they did the task. And so I had to learn some electronics because I had to build circuits to control the braking mechanism. I had to build circuits to measure the potentiometers which measured elbow and wrist angles. I had to learn how to program in C.

S2 03:16 Si.

S3 03:17 C, which is a--

S2 03:18 For our Spanish fans [laughter].

S3 03:20 Not si but C. Or maybe for those who are old enough to remember, there was

FORTRAN and then there was C and I don't know what there is now [laughter]. But that's what I used. And so I knew how to program in FORTRAN but I never knew how to program in C. But that was the way to have to control the device because C was designed-- work on PCs, and FORTRAN at that point didn't do such a good job because the study was done in 1991--

S2 03:53 Wow.

S3 03:54 --I believe.

S2 03:55 So we've kind of told the folks why it was memorable to you. So tell us a little bit about the study.

S3 04:00 Okay.

S2 04:00 What was this question that you were trying to answer?

S3 04:03 The question--

S2 04:03 Why'd you have to build all this stuff?

S3 04:04 The reason I had to build it all was we were trying to look at how the orientation of the forearm interacted with the muscles you use to flex and extend your wrist in rhythmic ways. In other words, looking at how the orientation of the arm or hand interacts with muscle activity patterns. And so what--

S2 04:22 Okay. So this is all kind of a brain motor control thing.

S3 04:25 All brain motor controls. So what had to be done is we had to start people, let's say, with their forearm supine. And then we rotated them around in steps of like a 20-degree angle until their arm was completely prone.

S2 04:39 So that was with their palm down?

S3 04:41 Palm down.

S2 04:42 Yeah, okay.

S3 04:42 Palm up to palm down. And then palm down to palm up. And so they were doing these rhythmic patterns and we looked to see if they could maintain a certain pattern throughout the entire rotation. Okay? And what we found is that if you started people doing flexion and extension, all right? When they're supine, you rotate them to prone, okay, they don't want to do-- if you do flexion-flexion between your elbow and wrist, and you rotate them supine to prone, they don't want to do flexion-flexion when their arm is prone. They want to do flexion-extension.

S2 05:18 So you're saying, so if their palm is facing up and you have them like they're--

S3 05:23 Rotated down.

S2 05:25 --rotated down.

S3 05:26 Yeah.

S2 05:27 And then you have them try to close their wrist, basically to point their fingers down to the ground.

S3 05:31 In a rhythmic way. They don't like to do that. They'd rather have their wrist and elbow go--

S2 05:36 The same way.

S3 05:37 --flexion-extension like that. And so what the study overall indicated is that an

important control variable is not just the muscles in terms of defining an action, flexion and extension. But it's the orientation of the body in space. Because in the area of motor control, that's always one of the big concept, is we have all these different joints and we can change orientation, and move in so many ways. How do the muscles map to all those spatial orientations?

S2 06:08 So and this is-- but this is all a function-- this is all coming from the brain. I mean, is that the master controller for all of this stuff?

S3 06:13 Yes. It is the brain.

S2 06:15 Yeah.

S3 06:15 And then it's getting feedback, though, from the muscles as they're moving around. And so the idea is that those two things interact to lead from a change in one pattern, which is comfortable with the forearm up, but becomes uncomfortable with the forearm down. And so the brain wants to say, "Oh, let's do something easier." And so it switches.

S2 06:36 So the application of this would seem to have a lot of application for people who have motor control deficits like stroke patients and a variety of other types of clinical populations.

S3 06:46 It would. I'm going to backtrack. Actually, that's what kind of made the study interesting is some people couldn't do the task. And they had no known neurological problems. But it just pointed to the idea that when we talk about coordination, for some reason some people are just more coordinated than others. And you can even see this in just very basic tasks. Okay. And then when you think about rehabilitation--

S2 07:14 We'll have our audience now try this.

S3 07:16 Try this [laughter]. Okay? And some people might get a little confused. I've actually used the same arm motions to study stroke patients several years ago. And we've also used the data from the most recent stroke group to design a 3D virtual reality system that we're now utilizing to train people on these different elbow wrist coordination patterns as a form of rehabilitation.

S2 07:46 But this all started back with this where you had to build the equipment.

S3 07:50 That's right.

S2 07:50 You couldn't buy the equipment.

S3 07:51 I couldn't buy it and I had to work with some technicians over in a lab that we had over on the campus at Florida Atlantic University.

S2 08:00 Which I'm aware of.

S3 08:01 You're aware of. And it took about six months to get it all put together. So I learned quite a bit. Yeah. And so that was-- it actually was my master's thesis, is what it was.

S2 08:12 And that's amazing because people don't realize that, to answer some of these questions, you have to go out and build your own equipment.

S3 08:17 Oh yeah.

S2 08:18 Because otherwise, the question doesn't get answered, or it can't be answered.

S3 08:21 No. Yeah. And with this new thing we're doing, we haven't had to build equipment so much, other than we've had to take pieces from here and there, and now get them all to link together because of the technology. So we're linking together 3D goggles,

along with a movement camera system, and then we're going to also try to implement a form of visual training with that. So we're using like three different devices.

S2 08:48 So you said one of the things that makes it memorable was that you didn't realize how hard this kind of research was to do.

S3 08:53 That's right.

S2 08:53 Was it hard because it was just getting everything to work together, or just that whole process of developing all the equipment, and then figuring out how to use it, or--?

S3 09:01 It was all of it put together. And it doesn't get any easier [laughter]. So this last one we're doing--

S2 09:07 You would think that after we've done this for a while, right [laughter]?

S3 09:09 That's right. This last one we're doing is just as hard, even though we haven't made the individual components. But figuring out how to get them all to talk to each other--

S2 09:17 Yeah. Program [crosstalk].

S3 09:18 --with today's technology is still a challenge.

S2 09:21 Yeah. Not unfortunately. But that's part of the story that people don't understand is that oftentimes the methods to actually collect the data that we need to answer the question. We have to come up with that stuff whole cloth, often.

S3 09:32 That's right.

S2 09:32 You have to sit down and figure out, "Well, what's the best way that we can do it?"

S3 09:36 That's right.

S2 09:36 Did you use that equipment again after that?

S3 09:38 I actually used it in one more study after that. So I used it in another study. And I finally took it apart because I used some of the parts in another study later [laughter]. So I got my use out of it.

S2 09:51 Yeah. So yeah, one of the pieces of equipment, I built it in doctoral program wound up being part of a beer distillery later down the road.

S3 09:59 Well, that's a even better usage, I guess.

S2 10:00 It wasn't mine, but it was someone else's.

S3 10:02 I mean, it was somebody's.

S2 10:02 So that's the other thing that happens with some of this equipment. It gets cannibalized and used for other things down the road.

S3 10:07 That's right. Oh yeah. I mean, you don't see that in journals.

S2 10:12 Right.

S3 10:12 So I couldn't write in there everything about what it meant to design a thing. I just have to say, "Here's the device. This is what it did."

S2 10:20 This is what it did. Yeah. Right. Right.

S3 10:21 And that's it. Yeah, so.

S2 10:22 So do you have any mechanical background? Does it come easy to you to build this kind of stuff? Because my perception is that this happens more often than not with

scientists, is they have to wind up building something to answer the question that they have.

S3 10:36 Well, I've always liked to take things apart and put them together. And so I still do that. And so I found it really a challenge, although it was very aggravating at times. But it was still a challenge to overcome, and it was fun, so.

S2 10:51 Yeah. Cool. John, thank you for being with us today.

S3 10:53 You're welcome, Tim.

S2 10:54 It's been great.

S3 10:55 Appreciate it.

S2 10:55 And for the listeners, we're going to have his paper up, this paper that he's talking about. It's going to be up on the website with the podcast. So if you'd like to see what the paper looked like when it got published, feel free to download it and read it, and put that in context with the things that you just learned about how hard it was to do the study because of the devices that had to be built. So anything else you'd like to tell the audience, John, before we go on?

S3 11:16 Just thanks for listening, and stay tuned.

S2 11:18 Yeah. Well, thank you for being here with us.

S3 11:20 All right.

S2 11:20 And thank you all for taking the time to download us and listen. Let us know what you think of this new format. And otherwise, we hope that you're with us next week, when we have another interesting person from the world of sports medicine and human performance with another story behind the study. And until then, we hope that you stay active and healthy. [music]

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