You're listening to Moving Ahead, The Physical Therapy Podcast by Washington University Program in Physical Therapy. In this episode, Dr. Linda Van Dillen, Division Director of Research, Professor of Physical Therapy and Orthopedic Surgery speaks with Movement Science Program alum, Edelle Field-Fote, Professor in the Department of Rehab Medicine at Emory University, Director of Spinal Cord Injury Research at the Shepard Center, former President for the Foundation of Physical Therapy Research, and Worthingham fellow. They discuss Dr. Field-Fote's path as a physical therapist to PhD, why she chose a PhD in movement science over other PhD options, and how her PhD education helped carry her forward as a scientist, academic, and mentor.

Linda: Hi, my name is Linda Vandillen. I'm a professor in department of physical therapy as well as in the department in orthopedic surgery at Washington University in St. Louis, and I am the director of Division of Research in the Program of Physical Therapy, and I am here today to talk to a friend and colleague of mine, Dr. Edelle Field-Fote. She is a professor in the Department of Rehab Medicine at Emory University, she is also a professor of practice at the Georgia Institute of Technology in the school of Applied Physiology, and she is the Director of Spinal Cord Injury Research at the Shepard Center in Atlanta, Georgia. She's also a Worthingham fellow and was the former President for the Foundation of Physical Therapy research. So, thanks to Edelle for being here today to talk to us.

Edelle: It's my pleasure. Thanks for having me.

Linda: Yeah, it should be fun. So, I'm just going to ask you some questions so we can get started. Tell us a little bit about your career path as a physical therapist before you pursued your PhD training.

Edelle: Yeah! So, I actually graduated from physical therapy school during the time when you could practice with a Bachelors of Physical Therapy. And, I went to the University of Miami. And it was a brand-new program and it hadn't been accredited at that time, but I took a chance, and it really was wonderful because it gave me the opportunity to see a lot of difference types of physical therapist practice very early, and very early experiences in the hospital setting. You know? When I was relatively young, still in undergrad. So, at that time because of the B.S. entry level, you came in, did a couple years of general education, and then you went right into physical therapy, the physical therapy program, physical therapy classes. And so, I feel like I had a wonderful opportunity to be exposed very early in my years to physical therapy. Also, during my time at the University of Miami, they had a really innovative program where at one of your internships, you had the possibility of choosing research. And I chose to do a research

internship at Washington University in St. Louis. And that's where I met so many wonderful people who really influenced my decisions later in my career. So, I worked with Shirley Sahrmann, I worked with Barb Norton, Tony Delitto, Mike Miller. It was really a wonderful time to be exposed to physical therapy early in my career, and it really set the path for me in the development of my career goals and my career in general.

Linda: So, given all of the people that you met, would you say that's really what motivated you to get a PhD? Were there other factors that contributed to your pursuit of a PhD?

Edelle: Well, I was always very interested in research, that is what motivated me to take that research internship opportunity when I was in undergrad physical therapy. So, I did practice for a couple of years and realized I was interested in some questions I couldn't have the answer to, either in my physical therapy training or in my attempts to understand more from the literature. At that time, I was really interested in the back injury. So, I had interested similar to yours, Linda, at that time. One of my early clinical roles – so my first clinical role was actually in a brand-new rehabilitation hospital that had just been developed a little bit north of Miami in centralized Florida. And it was brand-new, so everyone who was hired as physical therapists were responsible for developing programs. And so, I was responsible for developing the spinal cord injury program. That was my first exposure to spinal cord injury, and I really, really love it. And in my second clinical job, I had the opportunity to be more involved in research. That was really my motivation for leaving that first position and taking the second position. And in that second position, I worked at a pain rehabilitation research center. And I was really fascinated by the number of people who came to the center who had had repetitive back injuries. And I developed this theory that the reason they had repetitive back injury was because they lost the sense of their position in space. And I decided I wanted to pursue that question as part of a master's degree. And so, I did pursue that – at that time, got a degree that was an interdisciplinary degree in Industrial Engineering and Epidemiology, because the industrial engineers were so involved in understanding on-the-job injuries. And so, I pursued that question. I really thought early-on that it was a biomechanical question – the biomechanics of the back and how people lift, that kind of thing. But, as I was getting into it, I realized it really was much more of a neuro-physiologic question. And, I developed this theory that the reason people reinjured themselves is because the muscle spindles, which signal length and rate of change of length, were sending the nervous system inappropriate information after back injury. That was my early delving into trying to understand a clinical problem, and the interaction between biomechanics and neurophysiology, and that was really fascinating to me.

Linda: I think this is really funny, a little bit, because I started out in clinical practice treating people with neurological dysfunction, got interested in their movement problems, but decided

that perhaps I wanted to study the same kinds of movement problems, but in people without neurologic problems. So, I ended treated people with spinal injuries and spinal pain, and you did the opposite. It's pretty interesting. Really, the theme of our work is the interaction of the musculoskeletal system and the neuro system as they contribute to pain problems.

Edelle: Yeah, it's so important to not put yourself into one camp or another, because they are so intertwined. And so, I'm so happy that our profession has moved beyond this, "I'm an orthopedic physical therapist", "I'm a neurological physical therapist", and really understand that both components are so important for normal movement and health.

Linda: Right, right.

Alright, so once you knew you were going to pursue your PhD, tell us about the factors that went into the decision to be trained in movement science versus another discipline or another area of science.

Edelle: I think what motivated me to get a PhD was this question of the interaction of the biomechanics and the neurophysiology. The movement science really was the best choice and it was pretty clear that it was the best choice. I considered programs that had PhDs in physical therapy, but I really felt that the questions that I had really required that I be exposed to in-depth understanding of biomechanics and of neurophysiology. So, movement science – it did not take me long to come to the conclusion that that was really what I needed to do.

Linda: And so, what do you thing were the factors that contributed to your decision to pursue your training at Washington University? So, we have Movement Science, but were there other factors about the university that drove you to come to St. Louis?

Edelle: Yeah, so I was already familiar–of course Washington University has a phenomenal reputation–and I was already familiar with St. Louis, with Washington University because of my time there as an undergraduate research intern. And, I already had relationships that were established there. And really, had it not been for that, given that my interests were in biomechanics and neurophysiology, and that those are such strengths at WashU in terms of the interdisciplinary program in Movement Science, I am sure that even if I hadn't already known about the university and been comfortable at the university, that that would have been a top choice. I might have looked a little more that I actually did. Because I knew pretty early that that's where I wanted to go based on my interests and based on my prior experience there.

But, I think that had I hadn't been there that I would have ended up there anyway. And, I love St. Louis. You know, I think back to that Mary Engelbreit saying, "You ain't see cute till you've seen St. Louis." And I really feel that way. I love the Central West End. I love Forest Park. And WashU – so, I actually did my PhD work, actually, on the main campus, and it's a beautiful campus. I really enjoyed my time there.

Linda: Yeah, I think that the relationship between the medical school campus and the Danforth Campus has been a real strength for the interdisciplinary Movement Science Program because you are able to pursue work in spinal cord injury with somebody in the Department of Biology, so I think that's a real strength.

So, a little bit more about that, from the perspective a trainee, and now as a faculty member, what do you see as the strengths of the Movement Science Program and the environment of Washington University in particular?

Edelle: Well, I think that the major strength is that it truly is an interdisciplinary program, even though it is based in the division of physical therapy, in the Physical Therapy Program, it really makes use of expertise across Washington University. And I really saw that in my own training. I did my PhD work in a biology lab in the Biology Department on the main campus at WashU. I worked with an amazing neurophysiologist there, Dr. Paul Stein, who really is a leader in the study of spinal generated movement, central pattern generated movement, an internationally respected leader in that area. And so, the ability to work with, learn from, make use of the expertise of people within the physical therapy program and outside of the physical therapy program is really one of the major strengths. For me, also the movement science program really had strengths in the area that I was interested in understanding more about. So, the neurophysiology component, the biomechanics component. When I first started, I wasn't really sure if my interests were more in neurophysiology or if they were more in the biomechanics side. And being able to be exposed to both and have learned from people who had expertise in both and knew what they were doing in terms of the research they were pursuing, was a wonderful opportunity to really make a choice based on things that were really important to me. And then, when I chose to work with Dr. Paul Stein, you know, working on central pattern generated scratching in spinal transactive turtles, I saw that–I saw one of his lectures and I was sold. I thought that was just the most amazing thing I had ever seen, and that I what I wanted to learn. At the time, I did not think about whether, a physical therapist in expertise in turtle scratching behavior was going to be marketable as a faculty, but I found my path and I was really glad that I pursued that area because it's still fascinating to me.

Linda: That's great. That's great. You were able to meet somebody outside of physical therapy and find some relevance back to your profession, basically.

Edelle: Absolutely.

Linda: Okay, so, what are some of the things you've learned here in the Movement Science Program that you carried forward into your career as a scientist, as an academician, and as a mentor?

Edelle: So, I think that just in terms of the socialization of physical therapy, I feel like I had a really good socialization into physical therapy as part of my training at the University of Miami. But, when I got to WashU, the expertise of the faculty and their involvement in the profession really bumped it up a notch. And I really developed a commitment there to moving our profession forward in my chosen area of advancing research. Beyond the socialization, the specific content that I learned there was really so valuable to just foundation of my career. Despite my early misgivings, about whether or not people would be interested in a physical therapist who knew a whole lot about turtle scratching behavior, it wasn't long after, actually during my time I was there at WashU, a conference where I was touting to my colleagues—my other student attendee colleagues—this issue of my other peers, PhD students were giving talks, and no one was asking me to give a talk, and it was kind of a concern that maybe this was not a path that was going to get me into a research career in physical therapy. And someone said there at that conference, "You have to speak with this researcher who is here, Dr. Blair Calancie. He has this manuscript that just got accepted to the journal, Brain, and it describes a person with spinal cord injury that has these involuntary stepping behaviors that he believes are spinal central pattern generated behaviors. Just like what you're studying in turtles." And I went to speak with him. I found him there, and I went to speak with him, and we had lunch together. And he was at the Miami Project to Cure Paralysis, and that's where I went to my post-doctoral training, with his lab. And so, I feel like I came into it at the perfect timing. Because it was just the time—prior to that time, people were not really sure that humans had the same spinal level pattern generated circuitry that had been observed in the turtle. And in other mammals, like cats and dogs. There was this idea that through evolution, that those circuits had migrated more rostrally and more at the brain stem. But in fact, his work, this publication in Brain suggested that, you know, these same circuits that are present in lower vertebrates are present in humans as well. So, it was perfect timing. If I had come along five years earlier, it would have been too early. If I would have come along five years later, everyone would have already been doing it. Because I was taking that information and asking the question, "Can we train the central pattern generator in people with spinal cord injuries to

improve their walking function?" So, I was in there very, very early because of my knowledge at WashU and the serendipity of being there, you know, at the right time.

Linda: Yeah, I think that it's always a combination of passion for what you are doing, excellent training, and good timing.

Well, great. So, I talked a little bit about your background information at the beginning of this conversation. Tell us some more about your career path since you completed your PhD in 1995.

Edelle: Yeah, so I feel very fortunate to have been able to leverage what I learned at WashU as a scientist. And, I told you a little bit about that early work, trying to translate what we observed in turtles to humans with spinal cord injury. And so, I spent my first National Insitute of Health research award directed at whether we could train the spinal central pattern generator in humans with spinal cord injury. As you can see, I am coming back to where I started, you know, at my very first clinical job. It was at a brand-new hospital where I was responsible for setting up the spinal cord injury clinical program rehabilitation program. And so, I was really excited now to be coming full circle because I really love working with people with spinal cord injury. My first two, actually, NIH grants were related to the questions of whether or not we could train the spinal central pattern generator in people with spinal cord injury to be able to improve their walking function. And, in the first one, we discovered that combining training with physical therapeutic intervention, which in this case was stimulation, seems to be able to activate those spinal circuits well, and be able to improve walking function. And in the second study, we asked the question about whether training on the treadmill, which really capitalized on the spinal central patter generator because we are providing that afferent influence that drives the pattern generator, whether training on the treadmill was as valuable as training over ground. And this is an important question because when training over ground, you don't have that same kind of afferent input to drive the patter generator, and you are much more reliant on those descending circuits to activate. Go down through those remaining spinal pathways and activate the pattern generating circuits. And my belief is that the outcomes of that second NIH study really suggested that training the pattern generator was probably not the way to go. That people could walk pretty well on the treadmill, but it didn't translate as well to over-ground training—to over-ground walking. But then, people who training over-ground seemed to improve in terms of speed and distance to a greater extent than people who trained on the treadmill. And to this day, that study remains the largest study done on locomotive training in people with chronic motor and complete spinal cord injury.

So, based on those findings, my research kind of made a shift from looking activating pattern generator to how can we activate the brain to better activate those descending spinal circuits. And so, some of the studies in my lab currently are looking at the use of transcranial direct current in combination with different upright control activities to improve walking function. In

addition to the walking studies, this made the question about, well, if there is a function that is really dependent on the brain in people with spinal cord injury, it is hand function. It's about looking at how we can activate the brain to make the brain better at activating the hands. By increasing the transmission through those spinal pathways. We cannot really change the damage to the spinal pathway, but maybe we can make the remaining pathways more effective by making the brain more effective at sending information down through those pathways. And so, the studies in my lab were the first to actually use functional task method training. You know, this whole motor-learning intensive neuroplasticity approach that had been—that had come out of the spinal cord injury locomotive training literature—and now applying it to hand function. And we discovered some studies that suggested that peripheral nerve stimulation is valuable in nondisabled people, in that it activates the sensory cortex, which is a primary driver or motor-cortical activity. So, we started combining functional task practice training with peripheral nerve stimulation with the intent of activating the brain in a way to increase that descending drive. And since that time, we now use more direct methods of activating the motor-cortical circuits using things like transcranial magnetic stimulation, which is not really clinically accessible. So, more recent, we've shifted to things like transcranial direct current stimulation which is very easy to combine with physical therapeutic interventions with training. So, it started with the turtles scratching, but I feel it really evolved around a very logical way that has a high relevance for people with spinal cord injury.

Linda: Sure, I think it's great to hear somebody that has a career path that is very much the clinical work, the clinical application is based on basic science learning principles. And so, I think it's a great model for people to see a real advantage of getting that basic science training as a foundation to move forward to questions that are eventually going to be really important to the profession.

Edelle: Yes, absolutely, and I am glad you mentioned that. It is one thing that my lab is really, really committed to. By this time in my laboratory, I have had PhD and postdocs who are not physical therapists, who are basic scientists, and one of philosophies of the lab is we really emphasize things that are clinically applicable. So, for example, in my area of research, there are some really high-tech approaches. For example, when you combine transcranial magnetic stimulation with peripheral nerve stimulation and you have to figure out the timing to the pulse of the brain stimulation arrives at the spinal cord just later than the pulse that comes from the peripheral nerve stimulation. And so, this requires a lot of high-tech equipment. It requires a lot of extensive electrophysiologic training. It is not an approach that can be used—you have to keep your head still—so it's not an approach that can be used when someone is actually working on tasks the way they typically would. And so, my philosophy is that, even if that were really a valuable approach, how many people are going to have access to it? How feasible is it that the person is going to be able to keep up with the changes they have acquired in that

study? So, one thing that I think is really is important is that, after our studies, people are not cured, right? They have to continue practice and training in order to maintain the changes they have gotten. And so, doing things that are really accessible are critical: things they can do at home; things they can do with their physical or occupational therapist is really important.

Linda: Right. And I think it's great that once again, you are taking what you are learning, and trying to make it very clinically applicable and beneficial for the clinician as well as the patient. It's not worth it unless you can get to that level.

Alright, so, the last question is really about your leadership. You have had a lot of leadership roles in physical therapy and in the scientific community. What's your motivation for taking on these roles, which has been the most meaningful for you, if there's been one, and is there anyone at Washington University that inspired you to take on this path of leadership that you've taken on?

Edelle: Yeah, so I hope you don't mind if I take two different paths here. I feel like I have had two different types of leadership roles. So, one of them has been within the physical therapy profession. I have been very involved—well early in my career—I was very involved in what was then the section of Research Academy of Physical Therapy Research. And the Academy of Neurologic Research, I served as editor of neurologic research for twelve years. I just recently ended my tenure there. So, I was strongly committed to the leadership of those academies. But I think that the one that was most meaningful for me in terms of physical therapy profession was my role as a trustee and then president of the Foundation for Physical Therapy Research. There is no organization that is more strongly committed to advancing the physical therapy profession through developing and supporting the foundations of our physical therapist practice. And, it's an amazing organization. We have wonderful trustees. I know that, Linda, you're a trustee, so I am very pleased that you have stepped up into that role. And it's also one where within our profession, there's a strong commitment to and recognition of the value of research and the need for research to really develop and strengthen the foundations of our physical therapist practice. And so, I think I've answered two questions in one there. So that was my role and that was my motivation as well.

Outside of physical therapy, more in the scientific clinical community, one of my current roles is as the project director of the Spinal Cord Model Systems Center. And so there are—this is—the model systems are a program that is funded by the National Institute of Disability and Rehabilitation research. And that model systems program is really important for advancing the care of people with spinal cord injury. There are fourteen spinal cord injury model systems across the United States. We are funded on a competitive five-year funding cycle, and we just—two weeks ago—received word that we are funded for the upcoming '21 to '26 cycle. The Model Systems Program is committed to excellence of care, but also in promoting research that

advances care in people with spinal cord injury. And so, the fourteen model systems centers, in addition to the research that they do at their own sites, have to propose collaborative projects that are done along the different sites, working collaboratively. And so, it is just a really wonderful program that I think has—that really sets the bar for the care of people with spinal cord injury, and also for advancing care through research.

To your question about who at WashU inspired you to take this path, I would have to say there are probably two people that were most inspiring to me. They are Shirley Sahrmann and Barbara Norton. Shirley, of course, has been a leader in so many areas of our physical therapy profession. Early in my career, I served in the House of Delegates for a number of years and by that time, Shirley had already done her turn as a delegate. But you will find many, many pictures of her in the archives of her speaking at the House of Delegates and advocating for movement science and the role of movement in physical therapy and physical therapist practice. And Barb Norton, who is such a thoughtful thinker. She just thinks about things so deeply. And she has wonderful intuition about what areas are valuable to pursue and how to pursue them. I would say that those two people are probably the ones that inspired me to take my path in research and in leadership as well in the profession.

Linda: That's great. I would have to agree. Both of them have been inspiring to many, many, many of us who have gone through the ranks at WashU and gone to other institutions, such as you have. So, that kind of winds it up. Thanks so much for talking to me and to the audience. I have to say that you are a perfect model of physical therapist/scientist who is really contributed to the science as well as clinical care in terms of the patients' conditions. So, thanks very much for all of your time.

Edelle: Well, thanks so much to you Linda, and of course, I feel the same way about you. It's always a pleasure.

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