Wheelchair Mobility: Optimizing Driving in Power Wheelchairs

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- [Fawn] Today's course is Wheelchair Mobility: Power Wheelchairs, Optimizing driving. Our presenter today is Michelle Lange. She's an occupational therapist with over 30 years of experience and has been in private practice, Access to Independence, for over 10 years. She is a well-respected lecturer both nationally and internationally, and has authored numerous texts, chapters, and articles. She is the co-editor of "Seating and Wheeled Mobility: A Clinical Resource Guide," editor of "Fundamentals in Assistive Technology, "4th Edition," NRRTS Continuing Education Curriculum Coordinator, and Clinical Editor of NRRTS "Directions" Magazine. She is a RESNA Fellow, and member of the Clinician Task Force. She is a Certified ATP, Certified SMS, and is a Senior Disability Analyst of the ABDA. Welcome back, Michelle, so glad to have you!

- [Michelle] Thank you very much, Fawn, and thanks everyone for attending this course here today on optimizing driving. I hope it's helpful to you and the clients that you serve. This is the last of a long series of courses that are designed specifically to help someone prepare for the RESNA Seating and Mobility Specialist Certification. You can certainly take this for the content alone, and it should still be helpful to you and the clients that are using power and mobility that you're working with. But for those of you who have been tracking along and are preparing for this examination, I congratulate you on making it this far and I hope that again this series will help indeed prepare you for that test. This is a CEU-approved course, and so we have the following learning outcomes. One, the participant will be able to describe the pros and cons of various drive wheel configurations. Two, the participant will be able to list the tracking technologies based on an informal study. And the participant will be able to describe programming options to reduce responsiveness in a power wheelchair.

So this is what we will be specifically covering. We're gonna talk about drive wheel configuration and how that impacts someone's efficiency in their driving. Tracking technologies which also can be very effective in increasing driving efficiency and then

finally programming, which truly customizes the drive for the wheelchair user. So, you know, I am all about efficiency. I'm about efficiency in my life in general, trying to be as efficient as possible but certainly with my clients, trying to help them to be as efficient as they can be in their mobility. Now efficiency in a manual chair may sound like something we can wrap our heads around, but efficiency's also important in a power chair. It's easy to assume that someone in a power chair doesn't really have to exert a lot of effort, but we can increase someone's efficiency within that mobility base by either decreasing the amount of times they have to move the joystick, or the amount of times they have to activate a switch and decreasing the amount of time it takes to get from one location to another. That is the definition of efficiency, basically less effort, less time makes someone more efficient. This can be very very important in someone using power mobility. If someone has to exert a great deal of effort who has increased muscle tone, that may result in an increase in muscle tone, further increase, and decrease in motor control. In someone who has muscle weakness, this can lead to inefficiency, can lead to increased effort, increased fatigue, and as a result, this person may not be able to drive as long throughout their day.

Now when we're looking at an ultralight manual chair, there's lots and lots of education out there, including in this series, about how to appropriately configure an ultra lightweight manual wheelchair. And that's all about efficiency and self-propulsion. There's a huge movement to try to configure these ultralights effectively, to set them up just right, to teach someone the best propulsion methods. All of that's designed to, again, increase efficiency and as a result, decrease the risk of repetitive stress injuries. We don't always put that same amount of effort into power chairs. We figure out the best seating, we figure out the best driving method, and then this person is kind of off on their own. It's really important to look at efficiency in power mobility as well. So again, improved efficiency requires less motor effort, conserves energy, and reduces fatigue. So it's a big deal. Perhaps you work with clients who have multiple sclerosis. Well, in this particular population, we know that excessive fatigue can lead to a loss of

function, and unfortunately that loss of function can be something that the client may not regain. So if they lose, if they regress, that might be their new baseline. We sure don't want that to happen, and so this is why a lot of people with MS end up in a power wheelchair to start with is because the effort to self-propel a manual chair is too great. Once they're in that power chair, we want to further reduce the amount of effort required.

Again, in clients with increased muscle tone, this increased effort can lead to additional increases in tone and a resultant decrease in function. And then finally with clients who have muscle weakness, this increased effort can lead to fatigue and that can limit the amount of time the client can keep driving throughout their day. So we want to maximize someone's control, function, and time they're able to drive. You know, I've had funding sources let me know that time is really not a medical necessity, that it's more of a convenience consideration. But time is very important. It could mean I've crossed the street before the light's turned red. It could mean for a student that I've gotten to my next class on time, and with some energy leftover to actually learn something. If I'm employed, it allows me to move around my workplace in a timely manner so I can continue functioning in my job. Time is something that's important to all of us. Many of us feel like we never have enough time and in power mobility, even though it's easy to think, "Wow, this person's in this powered base "that can go really fast. "Certainly they have lots of time on their hands "compared to a manual wheelchair user," that's not always the case. So in talking about various considerations in increasing efficiency in power wheelchair driving, we're gonna start with the drive wheel configuration. And in power wheelchairs, we have front, mid or center, and rear wheel drive wheel configurations.

Here you can see pictures of each. In a front wheel configuration, the main driving wheel is biased towards the front of the chair, the front of the client's pelvis. In a center or mid wheel drive, the drive wheel is generally directly underneath the client, and in

rear wheel drive, it is behind the client. Now of course, there's other wheels. These are our casters. In a real wheel drive, we have one main set of casters in the front. In a mid wheel, we have four sets of casters that pretty much all react equally as the chair is turning. And then in a front wheel, we primarily have casters in the rear. Sometimes there's some small wheels in the front. They really don't act as so much a caster, they act more as an anti-tip.

So what are the advantages of a real wheel drive chair? Well, rear wheel used to be much much more common and some of our early power chairs were primarily rear wheel drive. Some advantages of these is they're very stable on a variety of terrains. They tend to handle going downhill, especially at a higher speed, with a little better control than our other drive wheel configurations. These are very much workhorses, and do well for heavy outdoor use. These tend to have the fastest available speeds and often have the greatest amount of suspension. Some of that is because we are trying to incorporate or accommodate various terrains. That ride can get rather bumpy so it's important to have that suspension in there. The drawback of a real wheel drive is of the three configurations, this has the largest turning radius. Now turning radius is a big deal when it comes to maneuvering around the environment. When I'm evaluating someone for a power chair, often someone is taking a tape measure out and they're measuring that chair and they're trying to make sure it'll fit within their environment. For example, go through a doorway. Well, all these power wheelchairs will readily go through a standard doorway. What really makes the difference is maneuverability, and a lot of that has to do with turning radius.

So imagine if you're trying to get into an elevator and you're in a power chair. The elevator door is certainly wide enough for you to get in there, but once you're in the elevator ideally it's nice to turn around so you can head straight on out when you get to your floor. That's the maneuverability factor, and rear wheel drive has a very large turning radius. Now most of the chair is in front of the client and that allows them to

see the chair as they're maneuvering around the environment, and that might make it a little easier to avoid obstacles. Another main challenge with rear wheel drive are these front wheel, or I'm sorry, these footrest hangers. These footrest hangers sometimes run into the front casters during a turn. So as someone is driving along, and they're going straight, these front casters are typically faced rearward like they are here. But as someone makes a turn, these casters become skewed at an angle and can bump into the footplate hangers unless they're not quite a bit ahead of these casters. That can be a problem for people with tight hamstrings who might need their feet tucked in closer to the chair, providing more knee flexion. So if this person needs a footrest hanger that's maybe at say a 90-degree angle, these front casters are going to bang into it unless the rider is a child and has a shorter leg length.

One thing that can help is something called a center mount where we have a different type of rigging here, and sometimes that can avoid this front caster interference in someone who needs a greater degree of knee flexion. We then have front wheel drive. Front wheel drive pulls the weight of the chair instead of pushing it. Similar to having front wheel drive on your car instead of rear wheel drive. If you have rear wheel drive on your vehicle, it's pushing your car along the freeway, whereas front wheel drive tends to pull it. That's how this works. Front wheel drive has actually been around for a long time, and the main company that offered this for many years is Permobil like you see here. And they have continued to improve their design over the years. There's some advantages of this. If we do not have these little wheels in the front, that again are designed primarily as a front anti-tipper, then this wheel's so big that as the driver approaches a low obstacle like a low curb, this front wheel will climb right over it. And so we have this obstacle climbing capability. Since there's not a true front caster, we can place these footrests really close into the body.

So someone's knees can be at 90 degrees, and again that's very helpful for someone who has tight hamstrings. We don't have to worry about the caster interference. These

little anti-tip wheels are rigid, they don't swivel around like the casters do in the back. This front wheel drive also has a small front turning radius. It allows someone to get nice and close, tight up to a work surface because there's just not any chair in front of them. It's mostly behind them. But there's a few disadvantages to front wheel drive as well. These tend to be a little less stable, especially going downhill. And as a result, tend to fishtail. So as someone's going at a faster speed, or especially going downhill at any degree of speed, the chair will fishtail. What does that mean? That means the back of the chair wiggles a little bit, like a fish's tail. Even if it's not that much, it can feel kind of disconcerting when you're driving this chair, to have the back of the chair wiggling around. It also tends to be tippy a bit forward when the client climbs on the footrest.

Well, wait a minute, climbs on the footrest? The client's not supposed to do that, right? Well, they're not supposed to and you can tell 'em not to, but they will do this because clients know this is a great way of hopping into the chair, if they're able to help out with the transfer. Or the caregivers might help the clients stand on these and then move down. Now typically these do flip up, that would be a better choice and have the client transfer directly to the floor. But knowing that that doesn't always happen, we have to keep in mind that this can be a little tippy. It's not like the whole chair's going to fall onto the floor, but you might pop up those back wheels a little bit and that can feel rather scary. Front wheel drive is not as fast as some of the other chairs on the market unless this is compensated for in the electronics. There's some ways of doing some programming to allow this to go a little faster. The reason is, if it gets really fast that back end tends to fishtail and so there's a reason why these aren't as fast. Now over the years, we've had a lot of improvement in design and this isn't as big an issue as it used to be. And the speeds on front wheel drive are certainly fast enough for the vast majority of people who use a power chair. They're just not as fast as some other options, particularly rear wheel drive. Also the suspension isn't as great as in a mid or real wheel drive chair. And then finally we have center wheel drive. Now center wheel

drive years ago was available. It first started showing up primarily on the Pride Mobility power chairs. This chair pictured here is a Quantum Rehab chair, which is under the Pride Mobility umbrella. But it's at the level of a complex rehab chair.

Now the early center wheel drive or mid wheel drive chairs had a lot of issues. They tended to be very unstable. Every time the client took off forward, the chair would rock backwards and if the client stopped, the chair would rock forward. And if the client attempted to go up a ramp, it would lift this center wheel right off the ground and only the casters would be in contact. So it was kinda like a reverse high centering, and it was a real issue. These chairs also didn't do well in varied terrain. So people were very excited when mid wheel drive first started coming out because it does have some advantages but there were some significant performance issues. Those have been almost completely eliminated with these complex rehab better designed mid wheel chairs. So let's look at some of the advantages. These have the smallest footprint, so if you actually get down there with your tape measure and measure width and depth, this is the smallest footprint of a chair. But what's even more important is it has the smallest turning radius and that's because it turns right on its own center. This drive wheel is almost directly under the client. Now there's some room for configuration changes here. This seat can be moved back a little, forward a little depending on what the team decides. But generally, the client is right over this which means that they turn right on their own center and because of that, it's considered to be a more intuitive driving platform. It just makes more sense. There's not as much to compensate for.

With a rear wheel drive chair, I have all this chair in front of me and I need to be careful as I'm driving around that I don't run into things with the front end of my chair. Driving a front wheel drive chair has a lot of chair behind the client where they can't see it. One of my clients said, "It's like driving with a big butt." And they're right, there's a lot of stuff behind you and it's easy to run into things with that. With a mid wheel drive chair, there's not as much in front or behind the client. It's all sitting right above this drive

wheel. Even though there's casters that swivel in the front and the back, the legs can easily be placed at a 90-degree angle. This picture here happens to be a center mount, but even if we have swing-away footrest hangers, we can place those knees at 90 for someone with those tight hamstrings. And this is a very stable base. The main drawback to center wheel drive is that still through very aggressive outdoor terrain, this can be a little more challenging and it's important to keep that in mind if you're working with a client who has real rough and tumble driving requirements, to make sure that you're choosing the right base.

I work in the Denver, Colorado area. Occasionally we see someone from Colorado or even Wyoming that literally lives out on a ranch and they're dealing with pastures. We really have to look carefully at what base is going to manage those terrains safely. So which drive wheel configuration is best for efficiency, 'cause we're talking about optimizing driving efficiency today. Well, for many people who are not a really good joystick driver, and for nearly anyone who's using some form of switch driving, mid or center wheel drive is generally more efficient and intuitive, and that's because to get from point A to point B, there's literally less movement of the joystick and less switch activations that are required. Why, because in rear or front wheel drive after completing a turn, the casters are skewed, they're turned to the side. And when the client goes to move forward using their joystick or a switch, the chair will be pulled off course. The client then has to compensate with additional movements of the joystick or switch activations. And for a really good joystick driver, they probably won't even notice. But again, for someone who's not that great a joystick driver or using alternative driving methods, this can reduce the amount of compensatory movements that are required. That can really improve efficiency for someone.

Other considerations when we're looking at drive wheel configuration. It is important to provide training to the driver, all the time, just basic driver's training. However, when it comes to drive wheel configuration we have to look at training that's specific to that

configuration. So for example, if you're driving down a hallway and you want to turn into a room, where you start that turn is going to be different whether you're in a rear, a mid, or a front wheel drive chair. So it's important to help the client work through that learning curve. Another important consideration is that it can be very difficult to change from one configuration to another. So if you're working with a client who is a long-term rear wheel drive person, driver, and now you're switching them over to a front wheel drive, it can be very difficult because the chairs drive almost in an opposite fashion. So it can be quite difficult to switch back and forth, same with front wheel drive to rear wheel drive.

I have found in my own experience that transitioning someone from front or rear to mid wheel is not that difficult. But front to rear, rear to front can be difficult. It's an important consideration, and I may choose to keep someone in their current configuration rather than make that change if I think it's too difficult for them. You know, if you have questions as we move through this content, you can certainly reach out to me or to occupationaltherapy.com after completing this course. I will include my contact information. This is often a time people might have some thoughts about drive wheel configuration and certainly welcome that conversation. Next we're going to dive into tracking technologies. It would be great if when I hopped into a power chair and started driving, and I gave a forward command, that was where the chair went, forward. But unfortunately, there's a number of factors that tend to pull a power chair off course, cause it to veer one way or another. One of those is a side-sloped terrain. Something like a driveway.

So let's say I'm cruising along the sidewalk, and now I've hit a driveway. Chances are my chair is going to drift off course, requiring me to correct my course. More joystick input, more switch activations. It might be like I've collided an obstacle with only one of my drive wheels, or one of those casters. That could pull my chair off course. Going over a low step or curb, ramps. I hit a door jamb. Any of those items can pull my chair

off course, particularly if I hit those at an angle. Soft ground, unlevel terrain will pull me off course. Bunched carpet, not my favorite! I tell ya if someone's driving indoors with a power chair, get rid of those area rugs. Sometimes they get wrapped right around the wheel but that will also pull someone off course. So who can benefit from tracking technology? Well, tracking technology, and we'll get into this more here in a minute, basically helps keep someone on track. So if they've given a forward command, that's where the chair goes. And despite slopes and ramps and uneven terrain, the chair will stay true to its track. That's what the point of tracking technology is.

People who could benefit from that is basically any client who has difficulty grasping and operating the joystick. If they're not a really awesome joystick driver, tracking technology's going to help them. And anyone who's unable to use a standard joystick, who uses any type of switch to drive their chair, will definitely benefit from tracking technologies. So why is this needed, well, again power wheelchairs, and this is really a design issue, struggle to stay on track after completing a turn because in a real wheel drive chair those front casters are skewed, in a front wheel drive chair the rear casters are skewed. And now when I give a forward command, it's gonna pull me off course. Varied terrain, slopes, inclines, basically our world is not made of flat smooth linoleum and because of that, we need tracking technologies to make the chair driving more efficient. Now unfortunately tracking technologies are optional at this point, they're not standard as a part of a power wheelchair. Since this is optional, it's something that I need to add in to my justifications to explain why this is required for the client, so it will be funded.

Well, my letters of medical necessity used to go something like this. "The client requires tracking technologies "to help them to be more efficient "in their driving technologies. "It takes less switch hits, or joystick movements, "and less time when tracking technologies are used." Well, there used to be a golden age of letter medical, letters of medical necessity where I could just write what I thought and that was what

was accepted and life was good. But over time, funding sources have been asking us to prove it. So there's assumption that tracking technologies improve driving efficiency, and it certainly seems to be based on some very logical arguments. But it hadn't been proven, so after begging various manufacturers to please try to track this data and not getting very far, I finally went out one day to one of our local hospitals with one of our manufacturers' reps. We created a course on a gym floor, and we had a single subject who drove through the course with and without tracking enabled.

Now we used an Invacare power chair because with Invacare at the time, we could turn tracking on and off electronically. So we left all the other programming alone, had the client go through the course four times with tracking on, four times without, and we simply counted up how many switch hits does it take to get from point A to point B with tracking and without, and how much time. So we had four different trials. Two of them involved the mid wheel drive chair and two involved a front wheel drive chair. With each configuration we did trials using three switches on a tray and with the head array. Now the head array is one of our most common alternative driving methods, and so we thought that would be a good one to include in our study. We did three switches on a tray simply because it represented a switch driver and because from a logistics standpoint, it was pretty easy to count how many times someone was hitting the switch. So each trial, each of the four trials, required the volunteer to follow the course three times with tracking enabled and three times with tracking not enabled. The switch hits were recorded and averaged for each trial, and the time was recorded and averaged for each trial. So with each of those three trials, we'd average a time and amount of switch hits.

Again, the programming remained unchanged. We didn't change anything else on the chair except saying tracking's on, tracking's off. So we're gonna watch two videos where you can see how this chair went through the course without tracking and how it did with tracking, and I think you'll see an obvious difference. So we'll start with our

video of no tracking, and our driver's getting ready to start. She's been instructed to try to keep that blue line right in the center of her chair. And you can see almost immediately those front casters have pulled her off course. As she tries to correct her course, you could see those casters remain turned to the side and that's exactly what pulls these chairs off course. Now when that mid wheel drive wheel tries to move the chair forward, it's being pulled to the side by those skewed casters in the front and the back. We tried to ensure that the course included 90-degree left and right turns. And there's one part of the course that requires her to do a 360-degree turn. Some of this can be rather frustrating to even watch how many turns are required. Imagine if you were driving this. Some people watching this have also mentioned that, "Well, boy, maybe someone doesn't have to be "that precise in their driving," but again if you can imagine driving through a room with furniture in it, you really have to keep on course. Right, at the end of this tape she is going to make a 360-degree turn. Wait, nope, 180, gotta get that right. There we go. And she's almost at the end. And done. So that took her a few minutes.

Now we're going to watch a second video. Same chair, same seating, same programming, but with tracking enabled. And we're just introducing the video here, and then she will begin. This is much less painful to watch. You can see that the driving is much smoother, and despite those casters being skewed at the end of a turn, the chair is able to track truly forward after she completes the turn. This information was presented after we finished the study at a couple conferences and one of the participants asked if she was aware whether tracking was on or not. We said, "Well, absolutely," she could tell that it was on and she definitely indicated her preference for driving with the tracking. And she's done in about half the time. All right, we'll go back to our PowerPoint now. So here were our results, those averages. In our first trial of a mid wheel drive chair with three switches on a tray, it took less than half the amount of switch hits to complete the course with tracking on, and about 38% less time. In a mid wheel drive chair with a head array, it took nearly 70% less switch hits to get through a

course and about half the time. With the front wheel drive, the times were also about half as much time and in the 70 percentiles less switch hits. And I think that shows the inherent inefficiency of a front wheel drive chair compared to the mid wheel drive chair. There are more compensatory switch hits required when using front wheel drive and so the tracking helped that much more.

So we now have demonstrated that tracking technologies have been shown to improve driving efficiency, and not just a little, a lot! Again, these are optional systems, so justification is required in our documentation. Now one of your handouts today is called Staying On Track, and it's a summary of this study. Feel free to use it, I do all the time. If I'm recommending a power chair, I recommend tracking technologies and I will say in my documentation that an informal study showed these numbers and I have not had a denial for tracking technologies since then. Now I really wish that the power wheelchair manufacturers would take tracking and make it standard. They know that this makes their chairs drive better, and yet it remains optional which is really sad. But it is the case and I think a lot of people are not benefiting from tracking because no one on the team is recommending it.

So I would encourage you if you're working with a client, they're getting a new power chair and you think they could benefit from tracking, and I tell you it's hard to make an argument for someone who would not benefit from tracking. Please remember to recommend this. All about optimizing driving. And finally, we're going to touch on programming. Programming customizes the driving performance of the chair for the individual, and yet I'm convinced that a lot of programming does not happen. That clients have very minimal programming that occurs to their chair, and then they're set loose with it and could drive much more efficiently if some basic programming does occur. So programming changes the driving parameters. There are general driving parameters, such as forward speed, turning speed, braking speed. There's also parameters that are specific to people using proportional driving methods, and

parameters that are specific to people who are using non-proportional or more of a switch-based option.

So why is this important, well, I always love to tell the story of Cathy. Cathy, when I met her, was 60 years old. She had cerebral palsy and she had been driving for a really really long time, like 40 years. She had had numerous power chairs, and certainly had seen an improvement in power chairs over that time. Well, she came in to the clinic I worked at for an evaluation and said, "I can't drive my chair, it's a piece of garbage." Well, I don't know how often you hear that. I hear that a little too often. "My chair is a piece of garbage." So I looked at her chair and I thought, "Well, you know, that chair "isn't looking too great, actually." And she said, "Oh, this isn't my chair. "This is my friend's chair. "My chair's at home, I can't drive it." So I knew there was a problem. This is a long-term driver. She had just received a new power chair that another team had recommended for her, and she could not drive it. She told me the supplier had been to her home three times to reprogram the chair and she still didn't feel safe in it.

So I thought a field trip was warranted. So I went out to Cathy's home, and sure enough, he was a brand-new power chair sitting in the middle of her living room. It was very shiny, it was a great chair, the seating was appropriate, and yet she couldn't drive it. So I plugged in a programmer. Now not every clinician is able to get ahold of a programmer or feels comfortable programming. I'm a little geeky that way, and so I do tend to do a lot of programming. But, you can certainly look at what's going on with a client and direct the supplier or technician as to how we need to change the performance of the chair. So I plugged in my programmer, and I could see the problem almost immediately. Now Cathy has cerebral palsy, right? She has large rather uncontrolled movement, though still could use a joystick and had been for many years. When I looked at the parameters, they were all set extremely high making the chair very fast and very responsive, and she didn't have enough motor control to use the chair in that way. As a matter of fact, it was programmed similarly to how I would

program a chair for muscle weakness, not for cerebral palsy. So I could see there was a problem, and I started turning things way way down. I hopped in, drove it around a little bit to make sure I thought it was close, and then invited Cathy to try it. She wouldn't do it! She was afraid of this chair. I happened to have my daughter with me at the time, she was only about eight or 10 years old. I said, "Hey, Aimee, hop in," she did, she drove fine. Cathy decided, "Well, if your eight year old "can do it I can do it." She hopped in and drove just fine. So why is this important? When we're programming a chair, we can customize a chair to drive very very well to help someone do their very best in their mobility. We can program a chair unfortunately so that it's undriveable or unsafe or both.

So programming is tricky. It needs to be done by someone who knows what they're doing but it should not be ignored. Cathy did not need a new seating system, Cathy did not need a new power chair, Cathy did not need a new driving method. Cathy simply needed a chair programmed correctly. So who's job is this, well, it often does take a team. So again, as an occupational therapist I happen to like programming. I don't always get to program a lot, but I do at times. It can be hard to keep up with because each chair has its own electronic system, they each have unique aspects to their programming. So it takes some practice. But the advantage of a team is that as clinicians, we can watch that client and say, "Wow, this chair is just too responsive, it's way too perky. "This client doesn't have enough control." And we can then direct someone who's good at programming. It might be the complex rehab equipment supplier, a technician, or the manufacturers' representative. So for example, if it's an Invacare wheelchair it might be the Invacare representative. And they'll know really well how to program that chair. And say, "It's just too hyper, what can we do?" And they'll know what parameters to adjust. So driving parameters affect the speed and responsiveness of the power chair, so how fast it goes, and whether it's kinda sluggish or too perky, that responsiveness of the chair. And these parameters are rather global parameters, they're not access method or driving method specific.

So again, they can increase driving efficiency, they can allow us to customize the driving to an individual's environmental needs, they can unfortunately make a power wheelchair downright dangerous. We can program different driving profiles. So for example, drive one might be programmed for driving indoors. I need to drive a little slower, I need to get around obstacles. Drive two might be for I'm outside, I need to go fast, I need my chair to be more responsive, I've gotta get across the street before the light turns red. Maybe another driving profile is I'm carefully getting up my ramp and lining up with my tie-downs in my van. So we can program each one of those profiles differently. There are also proportional specific parameters, so these apply to our joysticks that are out there. These include sensitivity, short throw, deadband, changing axes, three direction, and switch joystick. Now again, these tend to vary a little bit between manufacturers. Each of their programming terminology can be a little different, but these are fairly common options for programming.

So let's look at sensitivity. Sensitivity is how quickly the power chair responds to joystick movement. So when you first start moving the joystick at all away from center, it's how quickly things respond. Sometimes this is called tremor dampening because if someone has a rather tremorous movement of their hand, we want the joystick to ignore those tremors and we decrease sensitivity. If sensitivity has been programmed too high, the wheelchair's going to drive too perky. If it's too low, it's going to seem unresponsive and we might have a client who's pounding on their joystick, trying to get a response. If someone needs to change to a mini proportional joystick, we talked about this under our alternative drives course, due to muscle weakness, then sensitivity may actually have to be reduced because these mini joysticks are inherently so very sensitive. Another option is short throw. Typically a standard joystick has to be moved away from center a certain distance to achieve full speed. If someone has muscle weakness, they may not be able to push it that far, it's just too difficult. So we can enable short throw so that the client doesn't have to push as far to get to full

speed. But if we find that despite increasing sensitivity and enabling short throw for someone with muscle weakness is not quite enough, then it is important to consider switching to a different driving method, like a mini proportional joystick. Short throw usually can't be used with a mini joystick because the throw on a mini joystick is already very short. Deadband, kind of a weird, sounds like a name of some rock and roll group, but this is a very unique feature that draws an invisible line around the joystick, as we see represented by this red circle here. This is really very specific and designed for goalpost handle users.

So someone who has a spinal cord injury, say at C5-C6, may be able to use a joystick but will have difficulty grasping the joystick handle, and so instead may rest in this goalpost style handle instead. But gravity, when this person is not driving, tends to move the goalpost handle to the side and the engines, or not the engines , the motors of the power chair will attempt to engage. This will increase an inactive area so that until the client actively moves beyond this invisible circle, the chair won't start driving. This is specifically available on two of our manufacturers' electronic systems, Q-Logic and R-net. Q-Logic is available on Quantum Rehab chairs, R-net is available on a variety of chairs including Permobil and Quickie. A common request that I receive is to change axes, and this means basically swapping the directions of control. So now when a client pulls back on the joystick, the chair goes forward. Some clients find it easier to pull back than move forward. I'm reluctant to make this change because I first want to see if the client can learn to use the joystick in a more traditional fashion because eventually they're going to have to back up and that would require them now to push the joystick forward. But just know this is a possible programming option.

A similar one is called 3 Direction where you can control all four directions by moving the joystick in only three. So let's say that the client really has difficulty pulling back on the joystick. We can, I'm sorry, let me start over. The client has difficulty pushing forward on the joystick. We can swap axes so that now pulling back on the joystick

can be forward, but if this client truly can't push forward which would now activate reverse, 'cause we swap those axes, remember, they can push a switch, called a reset switch. And now when they pull back on the joystick, it's going to toggle forward and reverse. Left and right still work in a traditional way.

So three directions simulate four because we can toggle forward and reverse by hitting a separate switch called a reset switch. We talked about reset a little more in our last course on alternative drives. We can also set up a proportional joystick to act like a switch joystick which means any movement forward is going to result in true forward. Any movement towards the left is going to just go left, et cetera. We don't have that 360-degree control. Why would we take away that directional control? Well, some clients tend to veer so when they attempt to go forward, they might go off to the side a little bit and not understand why they can't move true forward. And so that's why we would use a switch joystick. Some people tend to use this with a new driver and then transition them to proportional control. I'm not a big fan of that myself, I'd rather try to get the driver to learn how to use that 360 degree of control until proven otherwise, and then if needed I'll change them to switch joystick use. We then have some programming parameters that are specifically designed for non-proportional drivers and not to totally overwhelm ya, but this is just a fraction of the programming options we have. There is a lot of programming that can be done, but just to touch on some more common scenarios where programming may be required when someone's using a non-proportional driving method.

Keep in mind too, I'm not sure why this is, but if you change the driving method on someone's chair, let's say from joystick to head array, you will most likely have to change those general driving parameters: forward speed, acceleration, braking. All of that will have to be reevaluated because when the driving method changes, those driving parameters don't seem to respond the same way. The manufacturers might tell you they do, and in my experience they do not. I need to double check those. One of

the driving methods we've talked about in our last course on alternative drives was single switch scanning. This is not something that I commonly recommend, I will try really hard to find another way for someone to drive. But if someone needs to use single switch scanning, there's a number of things that need to be programmed. This is an external scanner pictured here, it's used on Invacare chairs primarily but it can work on other chairs as well. It has its own programming mostly on board.

Other programming systems, R-net and Q-Logic, have their scanning showing up on their display. So basically the client hits a switch, they see their possible directions lit up, they are scanned forward, right, reverse, left. When the scan gets to the desired direction, the client hits and holds the switch to move in that direction. So programming-wise, we need to program the speed of the scan. We wanna make sure it's not too fast for the client. As they build competence, we might need to speed it up. Whether or not we scan something called mode, this allows the client to access other features of the chair such as power seating. Again, we talked about this mode reset feature in alternative drives. We can also change the pattern of the scan. People tend to go forward, left, and right more frequently than they go into reverse, for example. So we can have reverse scanned maybe half as often. Frequently we can change how many directions are scanned. It's possible to scan those diagonals in between, say forward and right, and that would be an eight-direction scan.

Now Mark 6i Invacare requires an external scanner, R-net and Q-Logic have their built-in scanning feature, and so we would program those features using the programmer. Q-Logic, which is on the Quantum Rehab chairs, has something called a two-switch option, and a three-switch option. That requires specific programming. It allows someone who only has two or three switch locations to move into four directions as well as activate or execute an reset command. And that allows them to access other features of the chair, such as changing their drive, toggling forward and reverse, getting to power seating. If this client's using sip n puff. Sip n puff works with

four pressures: hard and soft sip, hard and soft puff, and again we discuss this in more detail under alternative drives. From a programming perspective, we have to calibrate each of those hard and soft pneumatic commands. This is a little different depending on the manufacturers' programming.

But this is again where often a team effort is required. So maybe the manufacturers' representative or the supplier knows how to program this, but will need your help in determining or guiding the client in executing those hard and soft pneumatic commands. There's some specifics to keep in mind with this programming called ramping or sampling delay. All of this varies by electronics package. If someone's using this two pressure sip n puff that's available on Q-Logic where any two puffs is forward, any one puff is right, any two sips is reverse, any single sip is left, then we need to program that between time of those double commands. Again, a programming opportunity. Head array is a very common alternative access driving method. And one of the challenges with the head array is we have three primary driving switches: forward in the rear pad, left, and right.

How is the client going to access reverse? Well, we can program the system so that that reset or mode switch toggles forward and reverse. We could use standby where if the client does not make a selection for a period of time, the chair enters standby. They then choose what the next, next will happen with the power chair based on which directional switch is pressed. So out of standby, if the client chooses forward, perhaps the chair will enter driving mode. If they choose a left switch, they might be toggling forward and reverse. And finally, if the client gives a quick tap to that back pad, this is sometimes called rear pad, that will toggle forward and reverse and this is shown on the display. So the client knows where they are, if they're in forward or reverse. So with program, again for more information on these alternative driving methods, please refer to that course. In terms of programming, remember that programming customizes the driving performance of the wheelchair. In general, and then specifically for each driving

method. This is a lot of stuff to try to keep in our head, but that's again why we need a team to talk about what are the various options in programming, have we done what's required so this client can be as efficient in their driving as possible. Again, if you have any questions about this material, feel free to email myself or the folks at occupationaltherapy.com, and I will show you that contact information in just a moment.

I do wanna thank you for joining us for this webinar here today. I know your time is very valuable and I do appreciate you making this effort, and the benefit that it will hopefully have for your clients. We have a great resource on this topic that goes into more detail. Amy Morgan wrote a chapter on optimizing driving and power mobility, and it is in a new text available on "Seating and Wheeled Mobility: a clinical resource guide," and finally I will leave you with my contact information. Again, thank you so much for joining us for this course here today with occupationaltherapy.com.

- [Fawn] Thanks, Michelle, for another great talk. And thank you for such a great series. I appreciate all your time and effort in putting this together and if folks on this webinar today do not know of other courses, you can search either by typing in her last name into the search box or you can search out the SMS series, Seating Mobility Specialist series in the drop-down arrow. So I hope everyone has a great rest of the day, you join us again on Continued and occupationaltherapy.com. Thanks, everyone!