

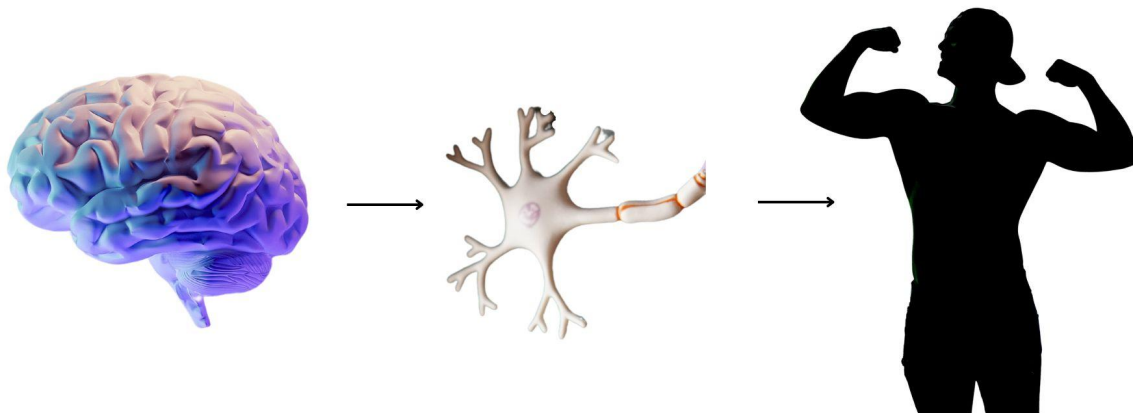
Chapter 3

Neuroplasticity: How & Why You Can Gain Strength... Even With a Progressive Disease

It's easy to doubt exercise's effectiveness for people with Multiple Sclerosis since MS is a progressive disease. Especially if you've exercised before and didn't notice much, or any, improvement. As you'll learn in this book, the reason for the lack of improvement could be due to several factors such as exercising with the wrong type of exercise, but it actually IS possible to get stronger, walk better, improve your balance, feel more energy, and so on. I'll outline exactly how to do this throughout this book, but it all starts with neuroplasticity. Neuroplasticity is the ability of your brain to get your neural pathways working, regardless of the level of demyelination. It's the reason that someone with a progressive disease like MS can get stronger and reach their goals. However, it takes consistency and time. I believe that to fully have hope that you can improve, you need to fully understand neuroplasticity - so well that you can explain it to someone else.

When I ask my clients, "What do you think needs to happen for a muscle to move?" Nine times out of ten, they tell me "I have to flex my muscle." This is a very common answer, and they're not wrong, but it's so much more than that. Misunderstanding the process of how our brain works with our muscles can often result in exercising in the wrong way, leading to no progress. Two things need to happen for any muscle to move/flex.

The first thing that needs to happen is your brain needs to understand what action you want to accomplish. This occurs either by a reflex, such as you step on something sharp and reflexively you move your leg, or by an active thought where you tell your brain that you want to move your leg. Let's use the example of bending our knees. Once we tell our brain that we want to bend our knee, the second thing that needs to happen is our brain needs to send that message down several neural pathways leading down to our knee. The third thing that happens is the desired movement, in this case - our knee bends.



Your knee won't bend if your brain doesn't think to bend and/or if the neural pathways aren't working. The reason this three-part sequence is important is that there are ways to exercise where you focus just on strengthening the muscle – which works great for people who don't have MS – then there are ways to exercise where you focus on strengthening the neural pathways which then leads to muscle strength. Can you guess which one is more effective for people with MS? You guessed it - the second option! However, when you have MS, the second part of the sequence, the neural pathway, is where the breakdown lies due to demyelination. So even though you're telling yourself, bend my knee, if your neural pathways aren't strong enough, the muscle can't flex as much or at all. This is where neuroplasticity comes into play.

What is Neuroplasticity?

Neuroplasticity is the ability of your brain to get your neural pathways working, regardless of the level of demyelination. This can be accomplished in two ways:

#1: Strengthening the pathways that already exist, but have been weakened. You'll know that your neural pathways are working if you attempt to move a muscle and it moves. You may notice the movement isn't as easy as it once was or it doesn't move as much as it used to, but you do see movement. This means that all three parts of the sequence (brain, neural pathway, muscle) are working, but the neural pathway is struggling to produce a strong enough force that you can fully move your muscle without resistance. Neuroplasticity is the ability to strengthen this neural pathway so that your

muscle gains strength and endurance.

#2: Finding a brand new neural pathway. If we use the example from above, if you attempt to move your muscle and you see no movement at all, this is a sign that your neural pathways have been demyelinated enough to the point where it's not working at all. Neuroplasticity is the ability to rewire your brain so that you can find new neural pathways for those pathways that have lost their ability to make a muscle move. Every time you attempt to move that muscle, your brain is going to attempt a new pathway to get from your brain to the muscle. There are millions (or who knows maybe trillions!) of different ways to get from point A (your brain) to point B (your muscle) via neural pathways. The only way to find one that works is by repetition – by practicing the desired movement over and over and over again. Even if, especially if, you have no movement in the muscle!

Let's think of it differently so we can fully visualize what our brain is capable of doing. Picture yourself driving to the grocery store. Let's say you always drive the same way from your home to the store. Now imagine that one day, you're driving to the store and there is a roadblock, causing you to return home and try an alternate route. That route, too, has a roadblock, so you turn around and go back home then attempt a different route. You'll repeat this until you find a way to get to the store (or maybe you'll just order groceries from Instacart, but that's not the point here!). Once you finally arrive at the store, even if the trip was rocky and uneven, you now know that this back road option is available and you'll continue to use it moving forward since your preferred route is closed. This road may have started bumpy however the more you take this path, the smoother and easier the trip becomes. Simply practicing the right type of movements over and over again will allow you to strengthen the pathway from your brain to your muscle, which in turn strengthens your muscles! So don't give up! Every repetition matters, even if there is little to no movement in the exercise you're practicing.

How Long Does Neuroplasticity Take?

Neuroplasticity can happen for anyone with MS regardless of your level of disability or the length of time you've had MS – seriously, I've had clients who have had MS for 37+ years and they were able to strengthen their muscles, walk better (with less foot drag & tripping) and feel more confident! If you have demyelination from MS, and if you have neural pathways that aren't working, that's not the end of the game for you. That doesn't mean that you can't get stronger. Use the strategies you'll learn in this book to help you create a plan of attack so that you start seeing and feeling improvements toward your goals!

You may be wondering how long this will take - valid question! Generally speaking, strengthening an existing neural pathway doesn't take as long as finding a brand-new neural pathway. At this time, no research provides a protocol for neuroplasticity. Meaning, no guide says "repeat each of your desired movements 50 times per day for 12 weeks and that's when you'll start to see improvements in your strength and mobility". I've had some clients who will do these repetitions over and over and over again, and truly within a few days, they will notice their knee bending better, or other clients where within three months they'll notice improvements in bending their knee. For other clients, it's six months. For other clients, it's a year. This is likely because not only is everyone's MS different from one another, but our brains are different, too. Many factors play a role in how quickly we're able to find or create new neural pathways. Some we can control (keep reading), others we can't control. Regardless, as you may be assuming by now, this takes a lot of resilience. Your brain can find a brand new neural pathway if it needs to, but it might take consistently doing that movement or multiple movements for a year, or perhaps a year and a half, without seeing results. So it's really important that you don't associate the amount of movement you see with success, but rather associate the amount of effort you're putting into each exercise with success. If we can tweak our mindset with success being a repetition of good quality versus success being a big movement, it's easier to stay consistent over the long haul because you won't feel like a failure.

Another thing we don't know, yet, is the effectiveness of neuroplasticity in spinal lesions. There is a lot of research on the effectiveness of neuroplasticity for people with brain lesions, but there is little to no research on neuroplasticity for people with spinal lesions. It's been a life goal of mine to find this answer. In my research from studying journals and talking with multiple MS neurologists and researchers, the assumption is that since neuroplasticity occurs in those with brain lesions, it likely occurs in those with spinal lesions. Additionally, there's no negative side effect to exercising with the goal of seeing neuroplastic changes if you have spinal lesions – the worst case scenario is your exercising doesn't result in physical improvements (but you will likely feel better due to more endorphins and still reap the benefits of general exercise such as improved heart health and brain health!). The best-case scenario is your exercising results in improved mobility, strength, and engagement in life!

Ways to Activate Neuroplasticity

Not only is it exciting that neuroplasticity is available to us, but there are things we can do to increase the likelihood of it happening! I've outlined six of the most widely known concepts to get neuroplasticity working.

1. Focused attention - The more focus you have on the exercise or activity you're doing, the more likely you are to see improvements due to neuroplastic changes. With focused attention, you can create up to 1.8 million new connections per second! So when you're exercising, try your best to avoid multitasking (thinking about what you'll eat for your next meal, how you're going to get your errands done, etc.). Your attention should be on the exercises you're doing at that moment so that your brain can attempt to figure out how to make the desired movement happen.
2. Alertness – Play a game to stimulate your mind and focus your attention. -Turn your exercise into a game lifts your leg high enough to tap your hand. Or do X duration of the chorus of your favorite song. Maybe toss a ball back and forth with a friend or by yourself while maintaining a good sitting or standing posture! -Take your brain off autopilot to learn some new movements!
3. Urgency - The more urgent a task, the more likely you'll see neuroplastic changes. A great way to build urgency into your exercises is to create some level of consequence. For example, if you're practicing balance, you could stand on an uneven surface with the consequence being falling/stepping off the surface. Or, you could score yourself, with the consequence being "losing" the game. Urgency works really well for people who are competitive with themselves, but it works for everyone! Find a way to build urgency into your movements.
4. Novelty - One simple way to get your brain to pay attention is to try something new! For example, try writing with your non-dominant hand. This is likely going to take much more focus and alertness than writing with your dominant hand. Making our brain try new activities drives neurologic change!

Setting these four factors in place creates the chemical conditions in the brain for neuroplasticity to take place. Once this occurs, the brain can begin to rewire itself. The more we prime our brain in this way, the more likely we are to see improvements in our mobility at a quicker rate. You can use these three factors in combination with your exercises or you can use them during your break. For example, after you complete one set of each of your exercises, attempt to write your name with your non-dominant hand. Or, take a break to play a 1-minute game of tossing a ball (or any game that makes you alert). Or between each set of exercises, practice a balance exercise where you feel the consequence of not wanting to step off the uneven surface. Always be safe with these games, you don't want to put yourself in a position where you lose your balance, fall, or injure yourself.

Last, but not least:

5. Saliency - The more meaningful the activity is, the more likely your brain will create neuroplastic changes. The easiest way to accomplish this is to create meaning for each exercise. For example, "This marching exercise will help me lift my leg higher so that I don't trip as often when going for walks with my husband and two kids." Or perhaps "this balance exercise will allow me to bend down to the floor to pick up the dog food bowl and feed my dog without falling over." Make sure you take time to think about what your goals are and how these exercises can help you reach your goals.

Exercise Guidelines to Increase Neuroplasticity in MS

1. Aim for perfect quality. Having perfect (or as close to perfect as possible) quality is extremely important. Your brain is going to strengthen the pathway for the movement that you're repeating. If the majority of your repetitions are performed with poor form than with good form, your neural pathways will remember what you practiced more - the poor form - and strengthen those pathways so that this movement keeps happening. This could significantly impact your quality of movement and may cause unsteadiness or even falls.
2. Repeat, repeat, repeat. To increase your odds of having your brain strengthen or find a successful pathway, you must practice consistently! Your goal for every exercise should be to perform as many repetitions as possible with good quality. The number of times you practice is equivalent to the number of times your brain attempts to find that pathway. Now, you may be thinking, "How am I supposed to do as many repetitions as I can but also have good quality? I'm going to get tired!". You're right! This brings me to my next guideline.
3. Rest! Take as many breaks as you need to. When you have MS, the goal shouldn't necessarily be to perform each exercise 10x, 3 sets, like we're often taught when growing up. You can set a goal of 30 good-quality repetitions, but that may take 7 sets of various repetitions, assuming you're fatiguing as you do more repetitions. For example, your first set is 10 but your second set is six, due to fatigue or you notice your form worsening. Your third and fourth sets may be four repetitions. Your fifth and sixth sets could be three repetitions. That's ok! Neuroplasticity doesn't require a bunch of exercises all at once, it just needs the cumulative amount to be a high number.
4. Choose a duration. Would you believe me if I told you research suggests exercise is equally effective if you exercise throughout the day or all at once? It's true! This means that you have the time and preference to exercise for 20-60 minutes all at once, go for

it! However, if you don't have the time, energy levels, or preference to exercise all at once, you'll get just as much benefit from fitting it in throughout your day. One idea is to associate breaks with one exercise. This way, you can pick an exercise and perform as many repetitions with good quality as you can within 5 minutes while taking rest breaks. Then later in the day, you do the same thing but with a different exercise. By the end of the day, you will have completed 4-7 exercises! Another idea is to multi-task and exercise while you're watching TV, on the phone with your friend, eating a meal, etc.

5. Exercise in different settings. Research shows you're more likely to feel improvements in various situations and environments (ie. you're walking better in your home as well as out in the community) if you practice your exercises in multiple locations. One easy way to do this is to practice exercises in different rooms within your home. Perhaps one day, you exercise in the kitchen. The next day, you exercise in the bedroom. The following day, the living room. And so on. To take this even further, try practicing some of your exercises outdoors (ie. walking, seated exercises sitting on a rollator, etc.). You could also do your exercises in your car, at a friend's house, in the waiting room for your doctors' appointments, at work, etc. Get creative!

One of my MSing Link members and in-person clients, Diane, was working on a goal of improving her strength when standing up, while also trying to "plop" down less often. I had instructed her on specific exercises to strengthen her leg and core muscles in addition to practicing standing up from a chair and sitting back down with control. She was staying consistent with her exercises and doing a phenomenal job when her husband attended a session and said "Dr. Gretchen, I don't know what magic you're doing in this clinic, but Diane can stand up and sit down perfectly when she is here with you, but as soon as we get home, she can't do it." As soon as he said that, I remembered the benefits of exercising in different settings. We immediately started performing the exercises in other rooms within the PT clinic as well as out in the lobby, in other offices, and even outside on a bench. Within one month, she was now able to perform this movement at home with much more control and strength. Both Diane and her husband were extremely happy.

6. Choose a plan. According to the National MS Society, 150 minutes per week is the desired amount of exercise to reap the benefits. Further research suggests that exercising 5-6 days per week for people with MS. This means that you could exercise five days a week for 30 minutes each day. Or, three days a week for 50 minutes. And so on. This can be cumulative or all at once.'

To take this a step further - research suggests switching up the order of your exercises! Don't always start and end with the same exercises. Mix it up!

7. Cardio first. Research shows that performing cardio exercises before functional strengthening exercises will prime your brain for neuroplasticity. Meaning, you're even more likely to find and strengthen neural pathways if you do cardio exercise first! This is newer research, so we don't know the exact guidelines, yet. No protocol says your cardio needs to be ___ minutes long at ___ intensity to be effective. Therefore, I guide my clients to perform any amount of cardio they can tolerate. Furthermore, I suggest using only your arms for cardio instead of your legs. This way, you're not tiring out your legs before your leg strengthening exercises. Some of my favorite cardio movements are sitting up tall with good posture while swinging your arms next to your body as if you're running, for one minute followed by overhead jumping jacks with just your arms for one minute and ending with punching your arms forward for one minute. This will get your heart rate up in no time!

Key Takeaways:

1. Neuroplasticity is the ability of our brain to strengthen neural pathways + find new neural pathways.
2. Strong neural pathways lead to strong muscles and improved mobility.
3. Neuroplasticity can happen for anyone with MS regardless of your level of disability or the length of time you've had MS
4. There are specific ways you can exercise to activate neuroplasticity and make it more likely that it will occur faster.
5. If you attempt to move a body part (ie. your ankle) and it doesn't move, it's not an excuse to skip the exercise, it's a reason to prioritize that exercise! Give your brain a chance to find a new neural pathway by repeating the exercise, even with no movement. One repetition = one bout of effort.
6. Have hope - research shows it's possible!

Resources:

Podcast episodes 3, 39, 96, 99