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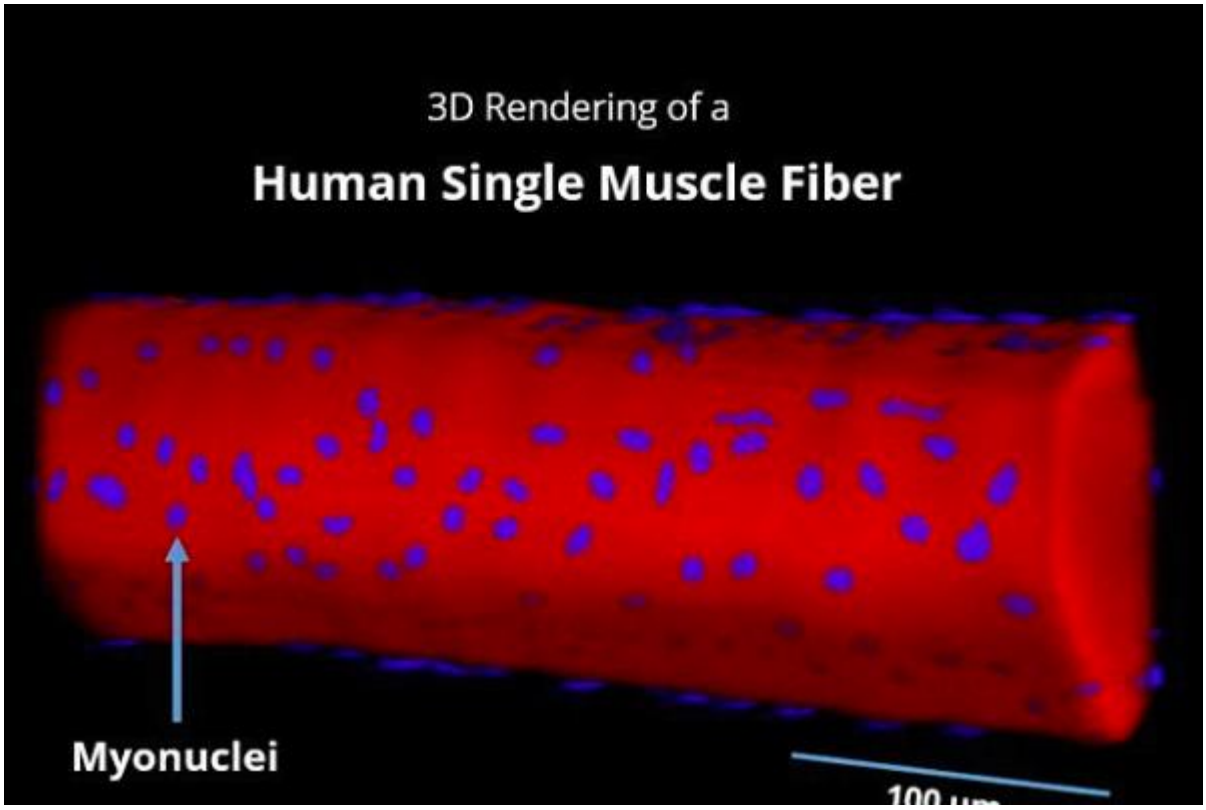
The new science of muscle memory

By Jimmy Bagley, PhD



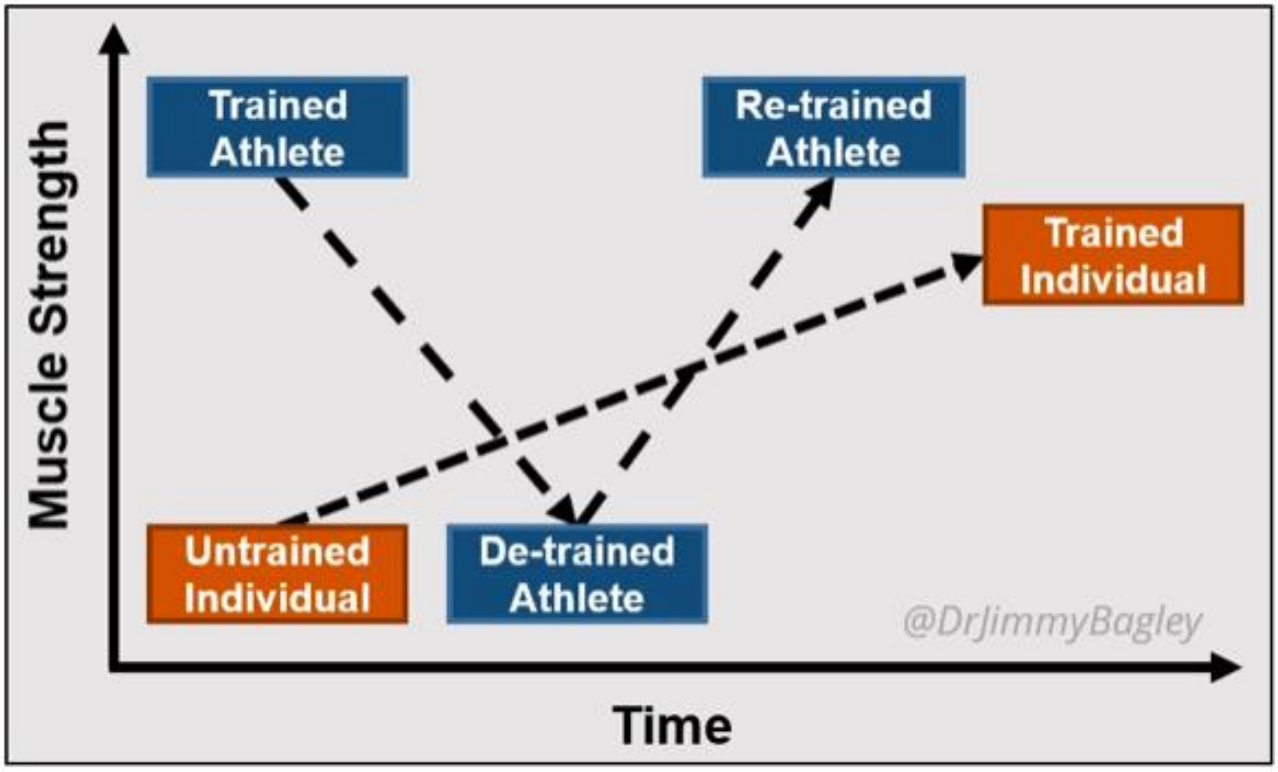
IT HAPPENS TO EVERYONE AT SOME POINT – An unwanted break in training.

You might have few crazy weeks at work or school, an upcoming move, new baby in the house, whatever. More commonly, an injury or some recurring joint pain will sideline you from time to time.

Whatever the cause, you might have noticed that it doesn't take very long to lose those hard earned gains in size and strength. In fact, visibly seeing the loss in muscle mass can be a little devastating (trust me, I've been there).

It may seem that all is lost, and you have to start back at the ground floor, but that's not so. New evidence in muscle science suggests that all of your hard work may still be paying off, even after months or years of de-training. In other words, you may have lost muscle mass and strength, but you can get it back way faster than you think.

Here's some cutting edge science for you. Check it out.



De-training, re-training, and 'muscle memory.'

Typically, the longer you go without training, the longer it takes to get your gains back. However, previously trained athletes and lifters can regain muscle mass and strength more easily than untrained individuals, even after long periods of inactivity and muscle loss (4, 5).

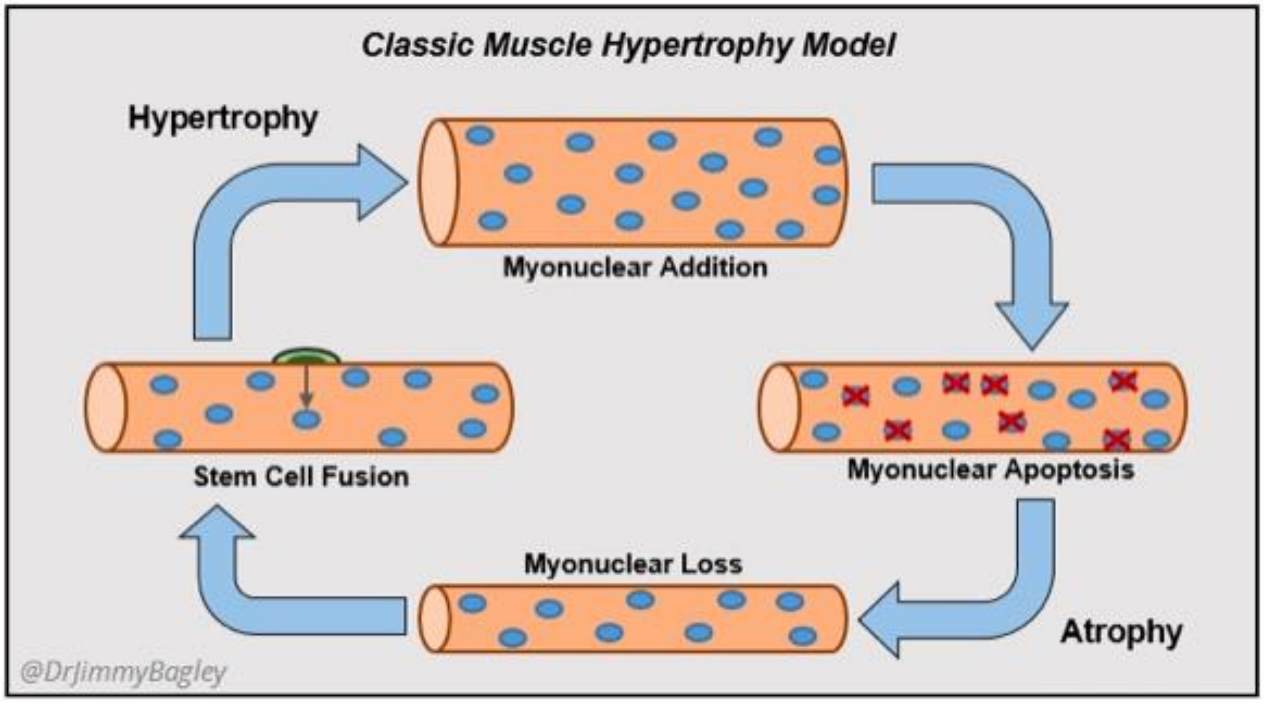
This is called the 'muscle memory' phenomenon.

You have probably heard of that, but the truth is that we're just now getting a better scientific understanding of what is all going on here. These long lasting memory training effects have historically been attributed to the central nervous system. But recently, an entirely different mechanism has been shown at the muscle cell level.

Muscle cells (or muscle fibers) are long, cylindrical cells that contain hundreds to thousands of little nuclei. Those are the little blue dots you see in all of these muscle pictures. The myonuclei are little control centers, allowing for the rapid, simultaneous, and coordinated growth and repair of muscle tissue. Bigger muscle fibers need more of these nuclei because each one can only support a small portion of the total cell. That area of control is called the 'myonuclear domain.'

Domain size is relatively constant under normal conditions, but it can increase or decrease depending on changes in muscle fiber size. For example, sustained muscle fiber growth (what many of us are hoping for) requires the addition of new myonuclei by muscle stem cells (satellite cells).

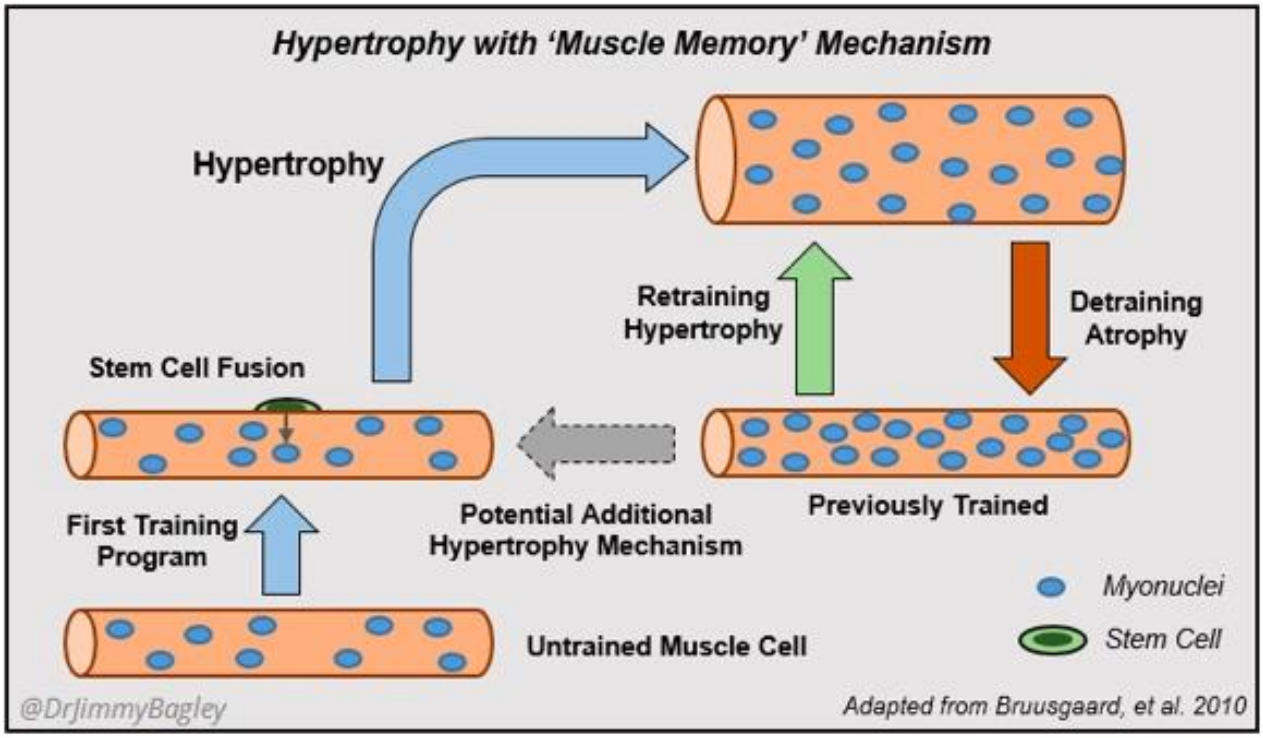
More myonuclei means more efficient growth and repair signals, which are required to adequately meet the growing cell's needs.



Classic hypertrophy model: What we used to think

We used to think that myonuclei were lost during periods of muscle atrophy. That classic model (shown above) suggests that the myonuclear domain remains constant with changed in overall cell size. However, what we're seeing now is that nuclei can be preserved, even during substantial periods of detraining and muscle mass loss (1-3, 6).

There is a clear preservation of growth machinery for future periods of growth. In other words, this is what muscle memory looks like.



'Muscle Memory' Mechanism: What we think now

Based on this new research, a brand new muscle mass regulation theory suggests that atrophy and muscle loss is NOT a degenerative, regressive process. The previously added nuclei (those muscle control centers) are more permanent than once thought (2).

Sure, muscle fiber size will decrease with de-training, but the added muscle nuclei from periods of focused growth and strength training will remain for a long time. That's a very good thing. Consider it a long-term investment in strength. This mechanism does make logical sense. It would be a total waste of resource for your body to create more nuclei, just to lose them all down the road.

This new muscle hypertrophy model may explain the 'muscle memory' phenomenon from the cellular level. While your muscles can't remember anything, the added nuclei do act as a sort of placeholder. This allows the muscle to regrow much faster and efficiently with a future hypertrophic stimulus (like weightlifting).

One thing we don't know is how long these extra nuclei actually stick around. It could be months, years, or forever, we don't know. This is actually the topic of cutting-edge muscle research currently **underway at Cal State Fullerton**. With that data, we'll have a much more fundamental understanding of how muscle adapts to training and detraining.

That will only help us all train more effectively and efficiently in the future.

So, what does this mean for you right now?

Your hard work in the gym is never lost, even after you've been out of it for a while.

Your muscle cells have used up valuable resources to make new nuclei. This will help support the growth and function of larger muscle cells. Even if those cells shrink during detraining, you will probably still have many, many extra nuclei ready and waiting. That will make it much easier for you to get right back to where you were before, and beyond.

Don't lose your motivation, and don't ever beat yourself up over lost gains. Life will get in the way of your training from time to time. This is inevitable, and as science is now showing us, no big deal. With nothing more than a little planning, you can bounce back much stronger than before.

Cheers,

Jimmy

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