



Muscle memory and imagery: Better tennis. An introduction

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ABSTRACT

Muscle memory is what determines your strokes and makes your tennis game what it is – for the good or for the bad. I propose the following laws of muscle memory. By understanding these laws, you can apply them to your training and your tennis game. You will become a better player

Key words: motor learning, acquisition, skill development

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LAWS OF MUSCLE MEMORY

Law 1 – Your tennis strokes are due to muscle memory.

Muscle memory is performing a specific specific motor action without conscious effort.

Law 2 – Muscle memory is the result of permanent changes in the brain, nerves, and muscles.

Your muscles “memorize” due to changes in the neural circuitry involving the brain, nerves, and muscles. This causes you to do it “that way” during a match. Technically, this is called “procedural memory”. It primarily involves retention of motor skills created by repetition. All the neural networks function together smoothly recreating the complex motor movement without conscious thought or attention. Once formed, these connections persist. They are permanent. A straightforward example would be riding a bicycle

Law 3 – Permanent changes occur through repetition in a concentrated period of time.

I define repetition over a concentrated period of time, as it applies to tennis strokes, as 45-90 minute sessions 3 to 4 times per week over a 3-week period. The practice time needs to be concentrated because the passage of time quickly erodes the neurochemical processes. Any skill obtained during a practice session is lost within 2 to 3 days if not reinforced.

Furthermore, the practice time needs to last at least 3 weeks (optimally) for permanent changes to occur related to muscle memory. For one example, 3 weeks is the usual time period for inpatient rehabilitation after a significant stroke or cerebral accident. That is, this is the minimal time period for new connections and skills to be really learned.

Law 4 – Repetition by doing it right is how you hit good strokes during a match

In order to train yourself to hit good strokes, the ones that win points, most of the practice strokes you hit must be good. Forget about immediate results. Repeatedly hitting good strokes is the way to get results that matter – the ones that make for a winning difference in your matches. The ones that stay with you over time.



For example, a student hits 250 forehands during practice. 25 are hit poorly as you warm up. The next 200 are hit in a mediocre fashion (the “so-so stroke” you want to improve). Then 25 are hit well because you have improved. One then tends to start another stroke. But what have you taught your muscle memory to do. The result is that you have trained your motor memory to hit poorly, or reinforced your mediocre “so-so” stroke 90% of the time. Little wonder one ends up hitting like always the next day. To make your good stroke into muscle memory, you must hit at least several hundred strokes after you start hitting it well. Science supports this. Joiner and Smith (2008, p. 2949) note, “after reaching a high level of performance during an initial training period, additional training that has little effect on performance can lead to substantial improvements in longterm retention”.

Therefore, good strokes are the result of muscle memory developed by doing it properly over and over again until the permanent changes occur. Muscle memory occurs by acquisition, then consolidation. Acquisition is the process of first mastering the skill. It is learning within a session, or perhaps 2 to 3 sessions. It is short term. It fades in just a few short days, unless reinforced. Consolidation is when you develop, master, and retain the skill by much repetition in a concentrated period of time. The result is that the motor skill (your “good” and much improved tennis stroke) is retrieved without conscious effort during match play. Consolidation is a slow phase of learning developed over many training sessions – days to weeks.

Law 5: Learning different patterns back to back may cause forgetting of the initial one.

In other words, a newly practiced skill is easily broken down or diminished. It is unstable. Therefore, when you add practicing another skilled motor activity immediately after learning the first, it creates “interference”. This disrupts the improvement that previously occurred. In one study, the authors concluded



that when the learning of a motor task was followed immediately by the learning of a second different motor skill, the “subjects were unable to benefit from their previous training” (Brashers-Krug, Shadmehr, & Bizzi, 1996). Another study notes “Interference with motor learning occurs when multiple tasks are practiced in sequence or with short interim periods... Analysis of movement after-effects suggested learning of the second task within 6 hours of learning of the first task led to an unlearning of the first task, or overwriting of the learning effects for the first task” (Chapman, Vicenzino, Blanch, & Hodges, 2007, p. 504, 513). That’s right, the previous training did no good. This means any and all benefit from the previous training effort were wasted. This biological fact is strong being confirmed across multiple studies. Simply put, if you practice your forehand then immediately practice your backhand, science suggests the short-term improvement in your forehand is transient, and will be lost in terms of long term retention. In effect, you just wasted the entire time spent practicing your forehand related to establishing muscle memory.

Law 6: Once your muscle memory is in place it “forgets” slowly, if at all.

This is why someone who played tennis in high school or college still plays well the first time out in 20 years, even if they have not picked up a racket during that time. Muscle memory is permanent. That path does not go away. To get better, what you have to do is make the new path, and have it be the preferred path. You do this by repeated use. The frequent use turns the new path into the preferred path. This is especially important in matches. You will initially have a tendency to return to the old memory path instead of the new one, until you train yourself to utilize the new path.

Law 7: The temporary improvement that occurs during practice or matches should not be considered learning, but rather a transient performance effect.

As noted previously, creating muscle memory is a very dynamic process. After a single (or even a few) session or match, any base for the improvement starts going away quickly, beginning in the 24 to 48 hour period after your practice – meaning, little if any basis for subsequent muscle memory is lost. When you practice just once, there is little muscle memory to build on 3 to 4 days later. Brain chemistry is constantly building and deconstructing all the time. Short-term memory (acquisition) erodes quickly. Per Vaswani & Shadmehr (2013), muscle memory “that was acquired during training decays immediately and automatically”. It only becomes long-term memory (muscle memory) by frequent repetition in a concentrated period of time.

Temporary performance improvement is an excellent thing to do 2-3 days before a match, but if you really want to really take

your game to a permanent higher level, you need to have Muscle Memory Practice. Temporary performance improvement is a transient effect – a brief reinforcement on the current pathways. It is acquisition, not consolidation. It does not establish new improved pathways. Instead it reinforces your usual game, or your previous practice session, so do not expect much more.

HOW NOT TO IMPROVE

Take a friend or a pro. Go out – hit some forehands, then backhands, etc. It does not matter that you did not hit that well. It does not matter if you never found a groove. After all, you got some “good” practice. You hit some balls, and got some practice in on all your shots, therefore you will get better. After all, “Practice Makes Perfect!”

Hopefully by now, with your knowledge of how muscle memory really works, you know how wrong that thinking is. What really happened is that you practiced (reinforced) your poor to mediocre shots. Even if you did hit some better than average shots (you probably did) – was it a high percentage? Usually not. Guess what –you play the way you practice. Practice does not make perfect if what you practice on a percentage basis is being mediocre (or worse). You so have to get over the mindset that to hit a bunch of balls makes your shots better, and/or makes you a better player. Practice does make perfect (or at least improves your skills) only if you mostly hit “better than your usual shots”. Also Law #5 suggests you should only work on one shot at a time during your practice

CONCLUSION

The best ideas are the ones that help you make better choices and take wiser actions. The book goes into Muscle Memory Theory and Practice – why it should work and how it is done. Science suggest there is a different way, a better way to train your muscle memory. Break away from the traditional training and try something different. Review the science and incorporate it with your knowledge and experience, tweak it, and come up with something useful.

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