



The Mountain: Part 2

The Breakthrough

Months later, I realized something so incredibly subtle that I had completely overlooked it.

I had overlooked it for 15+ years.

I was sitting in my computer chair testing different actions and reactions with my legs. I randomly pushed my left foot gently into the floor. I noticed that most of the physical sensation was coming from my left hip. My left quadriceps did flex slightly, but I barely felt it. I found that interesting, so I tested the right side. With the same gentle push through my right foot, I felt my right quadriceps much more clearly, along with a very small amount of sensation in my right knee. To my eye, the right quadriceps also appeared to flex more than the left. I sat there, puzzled. Then I tapped my right quadriceps and repeated the test. Immediately, I experienced more sensation in my right knee during the same pushing action. I tested the left side again and tapped the left quadriceps. This time, I experienced more sensation in my left hamstring and less in my left hip. I found this extremely odd.

The movement had barely changed. The amount of force was tiny, yet sensation seemed to ricochet through my lower body with the slightest change in sensory input. The perceptual signal appeared to be far more changeable than I had previously understood.

I began experimenting with other small sensory and physical inputs. Eventually, I was able to shift the sensation during the gentle pushing task until I could clearly perceive both quadriceps. Then something else happened that truly surprised me. I started yawning deeply and repeatedly. My eyes started to water as well. As I continued repeating the experiment, I stood up and noticed that the tension in my left low back was suddenly gone. It felt as if it had never been there.

I spent months repeating variations of this experiment. The results challenged much of what I thought I understood about the nervous system. Eventually, I decided to take the challenge further. I wanted to know what would happen to these changes under greater physical demand. I started loading my body more than I had in years. I was stunned by what I found. With specific types of load, I could deliberately provoke negative symptoms. In this process, I also discovered techniques that could rapidly improve those symptoms, sometimes with very little physical demand. At first, I wondered whether the changes in symptoms were primarily related to autonomic state. The yawning and watering eyes certainly made that possibility difficult to ignore. But low-back symptoms could also change rapidly without any obvious autonomic response. Something else seemed to be happening. I continued to explore.

If I was going to take these changes in perception seriously, I needed to know if the information had structure. I had always thought that subjective sensory signals could be unreliable, but these changes did not seem entirely random. I could apply a small sensory or physical input, repeat the same movement, and observe a different perceptual pattern only moments later. Sensation previously reported in the hip, knee, hamstring, or low back could disappear while sensation in the quadriceps became clearly perceptible during the same physical action. I had seen related changes before, but they had been inconsistent and usually involved much greater physical demand.

The changes were so disproportionate to the inputs that could create them that I questioned what I was observing for months. Eventually, I began to wonder whether the change in sensation might be telling me something about muscular contribution. If I performed the same movement and initially felt mostly my hip, then after a small input felt primarily my quadriceps, was I simply experiencing a different sensation? Or had something changed in how much those muscles were contributing to the movement? I could not directly measure muscular contribution, so this remained an inference. But the

patterns were consistent enough, repeatable enough, and reversible enough that I could no longer dismiss the possibility.

While this type of subjective reporting had obvious limitations, it was not necessarily disconnected from objectively measured muscular activity. I began looking for evidence that subjective muscular perception might relate to objectively measured activity. Duncan and colleagues found in 2006 that perceived exertion (RPE) within active musculature was positively related to measured muscle activity during progressively loaded leg extension.¹ I realized that these perceptual signals could be related to objective changes as well.

I began calling this process Selection: an apparent change in the contribution of a muscle during a specific movement. Perhaps perception was not merely something interesting to observe. If these changes were telling me something about muscular contribution, I began to wonder whether the perceptual signal could tell me something important about the state of the muscles themselves.



From Perception to Capacity

One of the things that shocked me most was how little the ability to complete a movement seemed to tell me about the individual muscles contributing to it. This became especially apparent when I looked at movement through this perceptual lens. Two people could perform visually similar squats and report completely different patterns of sensation throughout the movement. Even more puzzling, the same person could perform the same movement and report substantially different perceptual patterns only minutes apart following a brief, low-intensity input. The movement still looked successful, even though what appeared to change was how the body was producing it.

Another pattern was beginning to emerge from these findings. The apparent contribution of a muscle did not seem to change only after a sensory input. It could also change as I increased the physical demand of the movement itself. The question was not whether the

quadriceps contributed to the movement. Biomechanically, there was every reason to expect that it did. The question was what happened to that contribution as physical demand increased. Was there a point where the quadriceps could no longer tolerate the increasing demand and other muscles began contributing differently? Perhaps the perceptual transition I was witnessing was giving me a clue. I was beginning to realize that perhaps there was another variable hidden underneath my observations.

Over time, I started to understand why my original gentle push into the floor had become such a useful test. Pushing my foot into the floor required almost no meaningful global physical effort. I was sitting comfortably in a chair. Yet I could gradually change how hard I pushed. That gave me a simple way to increase physical demand while paying attention to what I felt. At very low demand, I might clearly perceive the quadriceps. Push slightly harder, and the perceptual pattern could change. A hamstring might become more noticeable, or I might begin to perceive more sensation in the hip, calf, knee, or low back. Reduce the demand, and sometimes the quadriceps would become clear again. That made me wonder whether perception was actually giving me a window into something much simpler than I had originally realized:

How much physical demand could this particular muscle actually tolerate?

This became especially interesting when I began comparing the gentle test with larger movements. For example, before a squat, someone might perform the seated foot press and clearly feel the quadriceps, with the glute secondary. Then they would squat. If the squat became predominantly associated with sensation in the hip or low back, we could immediately return to the same gentle seated foot press. Sometimes the perceptual pattern had changed there as well. The quadriceps signal that had been clear before the squat could now be difficult to find, while the hip or low back had become much more noticeable. And sometimes we could reverse the pattern again within minutes. I also began noticing that these changes could coincide with rapid changes in symptom location or expression. I started observing similar patterns across clients with very different backgrounds and presentations.

But one part of the pattern became impossible to ignore. A person could still complete a movement even when the specific muscular signal disappeared as demand increased. If that perceptual change reflected a change in muscular contribution, it raised an important possibility: the person's overall physical ability and the capacity of an individual muscle might be two very different things.

When we were able to maintain the specific muscular signal, a position that had previously been globally easy seemed to become extremely difficult to maintain. People often

reported intense, sudden fatigue in the targeted muscle during this process. That contrast forced me to separate several things I had previously treated as though they were the same.

The first was Global Physical Capacity.

This is simply what a person can physically do overall with their body. Walking five miles, squatting hundreds of pounds, playing a sport, completing a demanding movement, or producing physical output.

The second was Specific Capacity. How much physical demand can a particular muscle tolerate?

Those two things, I realized, could be dramatically different. Someone could have enormous Global Physical Capacity while an individual muscle appeared surprisingly weak. The reason this could remain hidden was almost embarrassingly simple: The body could still complete the movement. If one muscle could not tolerate the demand being placed on it, the movement did not necessarily fail. Other muscles could apparently contribute differently. The person could keep moving, the squat could still happen, and the athlete could still perform. From the outside, everything might look fine. From the inside, individual muscles might still be remarkably weak.

But if the body could successfully compensate for this weakness globally, why should we care?

Biomechanics offered an answer. Human movement depends on muscles working together to produce and control force. When one muscle is significantly weaker, other muscles may take on more of the demand. That relationship is not static. As weakness increases, the body increasingly has to compensate for it. Over time, that altered distribution can contribute to limitations in performance, pain, and even injury.

If Specific Capacity could reveal previously invisible weakness, the consequences could be profound.

I began searching established research literature for evidence that something similar had been observed in the past. Perhaps others had seen something similar in their own research, but catalogued it differently. A 2016 study by Calatayud and colleagues caught my attention. They found that people could use internal focus to selectively change the EMG activity of a specific muscle at lower levels of demand. But as demand increased, that ability disappeared even though the participants could still complete the exercise.²

That pattern looked familiar. The person could still perform the movement, but their ability to maintain the muscle-specific change was lost as demand increased. The study did not tell us why this happened. But it made me wonder whether Specific Capacity could be part

of the explanation. What if increasing demand had crossed a capacity threshold of the individual muscle, while the person still had enough Global Capacity to complete the movement? If so, the study might be showing something similar to what I was seeing in clinic: the capacity of an individual muscle and the capacity of the person to complete the movement might be very different things. The individual muscle may have simply been weak.

While Calatayud's findings were fascinating, they did not directly support my hypothesis regarding Specific and Global Capacity. Still, the similarities between what they described in their study and what I was seeing in clinic were striking. It gave me yet another reason to take seriously what I was repeatedly seeing in my own clinical work. Global physical ability might be hiding remarkably low capacity within individual muscles. Identifying potential weakness was important but exposed another problem. Now that we had found the specific muscular system, how could it be strengthened?

Normally, if one had thought a muscle was weak, the obvious solution was to load the movement more and progressively improve the capacity of the muscle in question. However, adding more load did not necessarily solve this problem. If increasing demand changed the muscular contribution, then adding more weight could simply make the body find another way to complete the movement.

This was not entirely different from the traditional idea of compensation. The difference was that I was trying to find the point where compensation began and inferring that a perceptual change might track with it. If I could identify how much demand a muscle could tolerate before other muscles began contributing differently, perhaps I could expose a weakness that compensation had previously hidden. Otherwise, the person might become globally stronger while the specific weakness I was interested in remained surprisingly difficult to uncover *or train*.

Our tremendous ability to adapt might cut both ways. That was the problem hiding in plain sight.



The Hidden Weakness

I began to see just how dramatic the mismatch between Global Capacity and Specific Capacity could be. Some of my clients could squat hundreds of pounds yet still had pain and limitations. They came to me with a history of low back, hip, or knee issues as well.

Initially, perceptual testing gave me the clue. Something about the quadriceps perception often did not match what I would have expected from the person's overall physical ability. But perception itself was *not* the capacity test. Load was.

Once I found a level of physical demand where the quadriceps could be clearly perceived, I could very gradually increase demand and see what happened. Signal often jumped from hip to knee to hamstring depending on demand and duration. However, when we kept the physical demand within the range where the quadriceps perception remained clear... something odd happened.

The visually strong quadriceps could fatigue rapidly, sometimes within seconds.

What surprised me most was the mismatch. The person might be capable of squatting hundreds of pounds, yet when I scaled the physical demand around the quadriceps signal, the muscle could develop intense fatigue under conditions the person considered extremely easy overall. The person was nowhere near their global physical limit, yet the quadriceps appeared to be reaching its own.

This was no longer simply an unusual sensory report. Perception had pointed me toward a specific muscle. When I began testing it with physical demand, it fatigued far more quickly than I would have expected from the person's overall physical ability. Fatigue was not the only thing that surprised me. When this weaker quadriceps system was exposed and trained, symptoms such as hip, low back, hamstring, or knee pain could disappear within minutes. Those symptoms were often on the same side of the body that perceptual testing had pointed me to.

Because of the speed of the changes, I hesitated to claim victory. Adaptation does not function at that speed. There had not been enough time or enough demand to create a strength change in 5 minutes. But the results were arresting, regardless of my understanding of the underlying mechanism. I continued to explore.

A consistent sensory pattern was beginning to emerge. Perceptual testing did not automatically tell me whether the muscle was strong or weak. It helped me identify where a potential muscular problem might be hiding. Load was what allowed me to investigate it. And sometimes, when I looked there with load, I found something remarkable. A person could possess tremendous overall strength and physical ability while an individual muscle

appeared dramatically weaker than that global ability would suggest. The person's overall strength had not necessarily disproved the specific muscular weakness.

It may have hidden it.

The movement was easy, yet specific muscles involved in that movement could be remarkably weak. Those were not contradictory statements. A muscle could flex, have substantial mass and be consciously felt. It could clearly participate in a movement. The person could also be extraordinarily globally strong. Yet none of those things necessarily told me how much physical demand the individual muscle involved in that movement could actually tolerate.

I began to reflect on what I had experienced with my own left leg. I was uncovering hidden weakness with clients, but my experience on the mountain seemed to be almost the opposite problem. My clients could appear remarkably strong while weakness remained hidden underneath. On the mountain, my supposedly weak left leg had suddenly demonstrated far more strength than I thought it had. Maybe the mountain had not created strength in my left leg during the hike but revealed strength I could not normally access instead. This brought me full circle back to the mountain.



Back to the Mountain

The mountain had been transformative because it showed me something I thought was impossible. From my vantage point, my “weak” leg had become my strong leg for a brief moment. For many months, that experience made me question whether weakness and strength could adequately explain what had happened. Now I saw the question differently. Perhaps hidden weakness had been part of my story all along, even contributing to my years of chronic pain, SI joint issues, and low back problems after the car accident.

Perhaps the months of hiking had finally built capacity that I had not previously possessed, while something akin to “Selection” was still missing. If so, the mountain may have created an environment where I was finally able to express strength that had already been developing underneath.

Maybe my leg had not suddenly become stronger on the mountain.

Maybe the strength was already there, and something had changed how much I could use it. It was possible that a change in muscular Selection had allowed capacity that already existed to finally be expressed. (That distinction would eventually become important enough to investigate on its own. I will return to it in the next article.) It was impossible to be certain, but I now had a way to investigate the problem that I had not possessed before. Perception could potentially help me locate the hidden weakness. Small sensory or physical inputs could sometimes change the muscle’s apparent Selection. And load could begin telling me about its physical capacity. After 15 years of research and 8+ years of clinical experience, I finally had a new way to approach the problem I had spent a quarter of my life trying to solve.



Continued Exploration

The clinical work rapidly evolved after my experience on Table Mountain and the subsequent breakthroughs. It gave me a new way to look at old problems. I quickly learned that the phenomenon I had been interrogating was also present in multiple muscular systems beyond the quadriceps. These included the biceps, hamstrings, pec major, rhomboids, traps, lats, glutes, obliques, abdominals and calves, among many others.

This understanding also gave me new ways to work with people my previous load-based approach could not reach. Some of my most sensitive clients had historically flared with

even minimal, low-load exercise. Previously, an exercise that appeared extremely easy globally seemed like it should have been an appropriately conservative starting point. But I had just seen how little global physical ability could tell me about the capacity of an individual muscle. I could no longer assume that an exercise considered low-load overall was also low demand for the individual muscle I was trying to challenge.

What if an exercise could be globally easy while still greatly exceeding the Specific Capacity of the muscle I was trying to train? This looked remarkably similar to what I had seen with athletes, only from the opposite end of the spectrum. Perhaps an exercise could be low-load overall while still placing more demand on an individual muscle than it could tolerate.

If so, “low-load” was not specific enough.

Low compared with what? Was it low compared to a person’s maximal strength or body weight? Was it low compared to what another person could physically tolerate? Or was my understanding of “low-load” still incomplete because it did not account for the actual capacity of the muscle I was trying to improve?

This fundamentally altered the way I thought about physical dosing of demand and load. Instead of asking only: Can this person complete the exercise? I began asking: How much demand can the muscle this exercise is intended to train actually tolerate? Perception gave me a potential way to navigate toward the answer.

Perhaps one of the problems is that we have traditionally been very good at measuring what a person can accomplish, but much less effective at determining how much capacity exists within the individual muscles being used to accomplish it. The body is remarkably good at solving physical problems. That ability is one of our greatest strengths. But perhaps it also creates a significant potential blind spot. Global Capacity might hide specific weakness. Perception may give us a way to find it. Selection may give us a way to change which muscles contribute. And carefully scaled physical demand may finally give us a way to test—and potentially train—the capacity that was hidden underneath.

The Future

I have recently entered a new phase of discovery. I am currently researching the longitudinal effects of this work on autonomic state, performance, pain, and strength. Each answer seems to open another door.

The mountain helped me find answers, but it has also created deep and powerful questions. There are still enormous unknowns. The current model has given me a way to investigate the phenomenon more precisely, but many of the deeper layers remain

unresolved. I am still uncertain about the underlying mechanism behind this phenomenon. Perhaps the mechanism is simple or even enormously complex. Perhaps it is ten mechanisms blended into one larger phenomenon. Whatever the case, I will continue to explore, test these ideas, and look for ways to better understand the body in hopes of improving health and realizing greater human potential.

Until next time

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1. Duncan MJ, Al-Nakeeb Y, Scurr J. Perceived exertion is related to muscle activity during leg extension exercise. *Research in Sports Medicine*.

2. Calatayud J, Vinstrup J, Jakobsen MD, Sundstrup E, Brandt M, Jay K, Colado JC, Andersen LL. Importance of mind-muscle connection during progressive resistance training. *European Journal of Applied Physiology*.