Introduction

If there is one thing that we need to live a productive and satisfying life well into old age it is functional capacity. What is quite interesting is that it is also what most older adults want. They might not want a hard, chiseled body or to be super-sexy (most weren't either of these when they were 20 years old anyway) but they ALL want to be able to do what they want without fear, limitation or pain. That is, they want function and I fully believe it is our job to give it to them. The primary question that this manual addresses is “How do we do that for our clients?”. In order to do that we simply need to follow the evidence. This document tells a story. The opening scene is set in the physiology of aging. While there whole textbooks devoted to this topic I have only pulled out some key facts and concepts that are critical to keeping in mind and sets the stage for the information to come. One of these keys is Nagi’s Disablement Model. By understanding how normal physiological declines and chronic diseases processes interact to impact a person’s functional trajectory you will be able to better understand how to design and implement interventions to change this trajectory and maximize function. The next section is devoted to describing functional concepts that are essential to high quality program design. These concepts are then integrated into the “7 Principles of Functional Training” specific to older adult clients. The story continues with functional assessment. After all you cannot evaluate what you don’t measure. Assessment is a key to developing individually appropriate interventions, knowing when to modify programs and documenting outcomes. While there are hundreds of assessment options I have chose those that have a solid evidence base, are easy to implement without complicated or expensive equipment and which I have experience using. Once we understand proper assessment then we can begin choosing exercises that will be effective for improving functional capacity. This information is heavily influenced by some of my own perspectives and philosophies in addition to the research literature. This includes some advanced topics such as power training and functional periodization. My hope is that this information will educate you but more so, I hope it challenges you to re-think your training strategies.
About Cody

Associate Professor
2005 IDEA International Program Director of the Year
ACSM Certified Exercise Specialist
ACSM Registered Clinical Exercise Physiologist
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About Dan

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Physiology of Exercise and Aging

Cody Sipe, PhD, CES, RCEP
Dan Ritchie, PhD, CSCS
Is it just repetitive to talk about the aging boom at this point? I don’t think so because I am still absolutely amazed at the fact that most fitness professionals (trainers, instructors, club owners) are still almost exclusively chasing after the 20 and 30-year old market. The 55+ market is growing exponentially and will continue to do so for the next **50 years** while the younger markets are going to remain either stagnant or decline. Plus you have to factor in three huge variables (what I like to refer to as the “perfect storm”): 1) The older population is growing exponentially with the baby boomers turning 65 at the beginning of 2010; 2) The older population has the most discretionary spending power BY FAR than any other demographic; and 3) The older population is EXTREMELY interested in maintaining their health and vitality as they get older. I could write a complete manual just on those three key facts alone and how they are going to impact fitness, wellness, health care and pretty much every aspect of our lives. If you check out the chart you will notice that the year 2010 begins a significant upward deflection in the population growth. This means we “ain’t seen nothin yet”!
Maximal oxygen consumption (VO2 max) is the gold standard of aerobic capacity. It is dependent upon many physiological factors listed above. There is obviously a huge amount of what we refer to as interindividual variability. This means that while a decline in aerobic capacity is inevitable (about 10% per decade) some decline more than others. This variability is due to a number of factors including physical activity level.

What this means, however, is that aerobic capacity affects functional capacity. At first, declines in VO2max are not noticed. After all how many people regularly exert themselves enough to notice? Not many. But our aerobic reserves are slowly declining as we get older. If it declines enough then recreational and then daily activities are impaired. Now it becomes overly tiring to walk around the block, climb the stairs, go shopping or play with the grandkids. If aerobic capacity declines enough then a person could cross that all-important disability threshold and become dependent upon others.

BUT if work on improving and maintaining aerobic capacity through regular exercise then we could be the next Everett Hosack (pictured above) who was still competing in international sprinting competitions at 103 years of age! Could Mr. Hosack hold a candle to a 20, 40, 60 or even 80 year old sprinter? Not likely. But I know 80, 70 and even 60 year olds who are not functional enough to even walk down the track….let alone run. So all in all he’s doing much better than his peers.

Potential pathological conditions: Hypertension, Cardiovascular Disease, Angina Pectoris, Peripheral Artery Disease, Arrhythmias.

Picture: 101 year old, world record holding sprinter Everett Hosack
The loss of muscle mass with advancing age, termed sarcopenia, is an important factor to address because it can have a dramatic impact on functional capacity. Look at the picture of the legs above. The first one is the leg of a healthy, active person with a high level of functional capacity. They have worked to maintain their bodies through regular physical activity and exercise. Because of the strength and power they have they are easily capable of getting out of a chair, climbing stairs, hiking, playing tennis, yardwork and many other necessary and enjoyable activities. The leg in the middle represents someone who is rather typical. They have not been as active as they could or should have been and maybe only engaged in exercise sporadically at best. Because of this they have lost an average amount of muscle mass and strength. They can perform most activities of daily living without too much difficulty. However, more vigorous and strenuous tasks are no longer possible. They have therefore modified their lifestyle so that they do not have to engage in these tasks. Maybe they moved to a one-level home so they don’t need to climb stairs. Or maybe they stopped playing tennis because they just couldn’t keep up with their doubles partners. This person has a little difficulty even getting off the toilet and may have installed a grab bar to give them a little extra boost. Whatever the case they have lost a good deal of functional reserve. These are high prospects for assisted living and are at risk of further decline into disability. The third leg shows someone who has lost a considerable amount of muscle mass. So much so that they are no longer capable of performing all of their ADL’s (activities of daily living). Now bathing, toileting, shopping, working, dressing and other tasks have become a chore and they need help with some or all of these. Can you say nursing home?

Type I (slow-twitch) muscle fibers show little change.
Type II (fast-twitch) muscle fibers decline 25-50%.

Muscle strength declines, on average, 30% between the ages of 50 and 70 with more dramatic losses after age 80. Large degree of variability between individuals.

Difficult to tease out the role of physical activity on the progression of sarcopenia.
Peak bone mass is reached at around 25 years of age and remains relatively stable until around the age of 50. After 50 progressive losses of bone mineral density occurs in both men and women. As bones lose their density they become weaker and the risk of fracture during normal insults increases. The two pictures above illustrate age-related bone loss. The bone on the left is healthy and strong. If this person were to fall it is very likely that they would walk away with a few bruises and maybe a little sore. The bone on the right has become weakened to the point of being osteoporotic. If this person were to fall they would likely break a hip, wrist or vertebrae (depending on the location of the osteoporosis). If bones become brittle enough (severe osteoporosis) they can break during even normal weight-bearing activities without a fall. In older populations broken bones are potentially lethal. Hip fractures are the number one cause of nursing home admission. Approximately 50% of those who suffer a hip fracture never fully regain their mobility and independence and 50% of those die within the first year. So a broken bone for an older adult is a very serious matter.

While women are three times more likely to develop osteoporosis than men about 1.5 million U.S. men, or 20% of those diagnosed, over the age of 65 have osteoporosis. There are a number of lifestyle factors that influence whether a person develops osteoporosis including ethnicity, vitamin C and D intake, physical activity level and certain medications.
Here is the criteria that physicians use to diagnose bone loss. The SD stands for standard deviation from the mean. This is a statistical term that basically refers to how far away from average a person is. If they are within one standard deviation from the average bone density score then they are still considered normal. Once they get below that, though, they are labeled as having osteopenia. Osteopenia is a higher risk condition where there has been evidence of bone loss but not quite enough to be considered osteoporosis. Individuals with osteopenia can typically still engage in pretty much any exercise and be okay. They are also great candidates for exercise programs to improve their bone density back up to the normal range. As BD continues to decline then they may be diagnosed with osteoporosis which is 2.5 standard deviations below the mean. Their bones are weak enough now that this must be a consideration in exercise programming. The spine, hips and wrists are especially prone to fractures from falls, impact or excessive strain. Because of this they should avoid activities with a high risk of falls such as bike riding, skiing or sports. In addition, excessive spinal flexion especially with resisted rotation should be eliminated from their program. Improving abdominal and core strength through static exercises such as planks and bird dogs are much better choices. Those with severe osteoporosis are in need of rehabilitation strategies as the stress of lifting heavy weights may cause a fracture. Although the level of bone density loss may be similar in osteoporosis and severe osteoporosis the presence of fragility fractures causes great concern.

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<tr>
<th>Condition</th>
<th>Bone Density Score</th>
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<tr>
<td>Normal</td>
<td>&lt;= 1 SD below</td>
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<tr>
<td>Osteopenia</td>
<td>&gt; 1 SD but &lt;= 2.5 SD below</td>
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<tr>
<td>Osteoporosis</td>
<td>&gt; 2.5 SD below</td>
</tr>
<tr>
<td>Severe Osteoporosis</td>
<td>&gt; 2.5 SD below and fragility fractures</td>
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*Diagnostic Criteria for Osteoporosis Based on Comparisons to the Young Adult Mean Bone Density*

Kanis, J.A. et al., J. Bone Min Res 1994, 9:1137-1141
So I want to wrap all of this up for you a little bit and make some final points on the physiology part. For one it is important to realize that older adults are not merely the sum of their chronic diseases. And they should not be treated as such. Nor should it be assumed that just because they are older they are going to have a whole bag of disease conditions. They may but they might not. The most important part of understanding all of this physiology stuff is its impact on functional capacity which is what I am going to talk about next. A slowing of neural conduction speed only really matters because the functional implication is potentially a slower response time for the initiation of muscular movement. That may put someone at risk of injury when put in a situation of danger. A classic example is in the case of a trip or a slip. When this occurs a very rapid response must occur so that the individual can adjust their center of gravity, step forward, grab a stationary object, turn or tuck their body into a safer position for impact with the ground, etc. A slowed response can make the difference between an injurious or life-threatening incident and a “whoo that was close” non-incident. As we will discuss later these physiological declines vary greatly between individuals (much more than we typically discuss) and therefore affect individuals to varying degrees. In addition, it is either the severity of these declines or the accumulation that makes the biggest impact. A severe decline in just one area can greatly impact function but severe declines are more than likely going to be due to a specific disease process. Conversely, less severe declines in multiple areas or systems can have an additive affect and therefore impact function as well. These smaller declines are likely to to 1) the innate aging process and 2) the impact of their lifestyle.

Of course we also have to recognize that many factors beyond their control that have NOTHING to do with the aging process can also impact these areas. For example, if an individual was a low-birthweight baby or was premature; if their mother smoked during pregnancy; if they had poor healthcare early in life; if they experienced a major injury during childhood; and the list goes on and on. These early life experiences can exert an influence on the health and function of adults much later in life (this is known as Life Course Theory).

### Aging Physiology

- **Brain/CNS**
  - Loss of neurons
  - Slowed conduction speed
  - Reduction in neurotransmitters, receptors and quality of response

- **Hearing/Vestibular**
  - Mechanical impairments
  - Loss of hair cells
  - Loss of neurons

- **Vision**
  - Contrast acuity
  - Color differentiation
  - Less light to retina

- **Somatosensation**
  - Loss of mechanoreceptors
  - Loss of cutaneous receptors

- **Musculoskeletal**
  - Muscle atrophy (esp Type II)
  - Loss of motor units
  - Loss of muscle fibers
  - Altered fiber direction
  - Reduced contractile velocity
  - Cartilage deterioration
Due to the cumulative affects of aging and physical inactivity a certain percentage of older adults struggle with performing many basic functional tasks such as walking, climbing stairs or stooping. About 1/5 of women and almost 1/3 of men are unable to perform at least one common functional task. Those who are unable to perform one task are much more likely to be unable to perform additional tasks. In addition, the likelihood of functional impairment increases with age.

However, the flip side of this data is that 70-80% of adults over 70 years of age do NOT have any major functional impairment.
With advancing age disease risk typically increases. The most prevalent age-related chronic disease conditions include arthritis, hypertension, heart disease, cancer, diabetes and stroke. Osteoarthritis often leads to some of the functional impairments mentioned on the previous page and as we will discuss later as we look at the Nagi Disablement Model. What is important to also note is that exercise is recommended as both a preventive measure and as an effective means of management for each of these conditions making it even more vital that older adults regularly engage in an effective exercise program.
Healthy Picture from photographer Etta Clark is of John Turner at age 67. A psychiatrist, John leads a sedentary professional life ("I sit and listen to people all day"), so he compensates by weight-lifting, jogging and taking long walks. I actually have a poster of this guy in my office. The caption on the bottom reads “Growing Old Is Not For Sissies”. It is a great conversation starter but also a testimony to the many who don’t take aging sitting down. While the innate aging process cannot be stopped exactly how well we age is largely in our hands. The choices we make everyday regarding physical activity, exercise, nutrition, exposure to environmental hazards, self-care, etc. are all major factors affecting the aging process.

These pictures represent the reality of the aging population and that is there is a huge spread of functional capabilities. In fact, physically they really are the most diverse population segment. We have the Everett Hosacks of the world competing in sprint competitions in their 90’s and 100’s and we have individuals in their early 60’s who struggle to make it across the room. Therefore someone’s chronological age really has much less significance than their physiological or functional age. If you work with older adults long enough you will gain enough experience to know that when you begin to stereotype or pigeon-hole people based on their age you’ve blown it big time. They will always surprise you.

The question we really must ask is “what is this person’s aging trajectory?".
This graph shows that merely assessing an individual at one specific point in time doesn’t necessarily tell the whole story. Two people may be similar in their functional capabilities at the same age and yet their aging trajectories are quite different. The orange line demonstrates the typical trajectory which begins to decline rapidly after the physiological peak in mid-life and is very likely to result in the individual becoming disabled sometime in late life. The blue line represents how an individual can slow down this deterioration (cannot stop it completely) thus maintaining high functional capacity and avoiding disability. Senior athletes are a prime example of this. Because of their commitment to training they are highly functional even into very old age. There is still some declines that occur because you cannot stop the aging process. This is seen in record times in many events. Athletes cannot maintain their same levels of performance and therefore performance declines each decade even though they continue to train.

But people understand the importance of function. I often ask older audiences which of the two possible scenarios they prefer. One, they live to 100 years but during the last 10 years they cannot care for themselves and must rely on family, aids, healthcare workers, etc. Or two, they only live to 85 years BUT they are fully capable and healthy right up until the day that they die suddenly in their sleep. I have never had anyone yet choose option #1. They always choose #2.

So one of our primary goals should be to maximize functional capacity and positively alter the individual’s aging trajectory so that they can maintain optimal function and quality of life.
The question I like to ask is “Are the traditional guidelines able to maximize functional capacity and dramatically alter the aging trajectory?” Here we see the ACSM guidelines for aerobic exercise for older adults. Honestly, it really doesn’t differ significantly from the aerobic guidelines for younger adults.
And here we have the guidelines for resistance exercise for older adults. The recommendations are very broad, generic and open to considerable interpretation. Now to give ACSM some credit here we must recognize that these guidelines are population-based. That means they are not targeted to a specific individual or sub-population. And if more people just got up and followed these recommendations they would certainly benefit from them. However, my concern is with the individual and experience tells me that these guidelines are almost, but not quite, what is needed to maximize and maintain function.
Is following these basic guidelines enough to maximize function and prevent disability in aging adults?

The evidence says “probably not” for many people.

Why not? Why aren’t they enough? For one that is not really the intent of the guidelines. ACSM has a strong history of creating guidelines, based on the current evidence, to help people avoid or manage a chronic disease condition. This is certainly one of the concerns of older populations – disease risk and disease management. So the committee that produces the guidelines must look at a myriad of factors, co-factors and outcomes.

So we really cannot use these guidelines for individuals although they are good for populations. If we are speaking at an event or writing a lay article then it’s good to tell people what the guidelines are because they will definitely benefit from following them.

However, when we have an individual in front of us looking for help we have the opportunity to go deeper in order to develop a customized program that WILL maximize functional capacity.

Let’s take a look at what the evidence is saying.
This study really sparked a fire for me and got me even more interested in uncovering the best methods for improving function with my older clients. You see there was a landmark study in the early 90’s by Fiatarone and Singh that demonstrated the capability of people as old as 100 years to build muscle through high-intensity resistance training. At that time many people thought that older adults were incapable of regaining muscle and strength. Some even thought that lifting weights would be dangerous or even fatal. This study caused sweeping changes. Attention shift to combatting sarcopenia and building muscle mass as a primary strategy for improving function and avoiding disability. But my training and experience told me that this was only one part of a larger equation. The Keysor and Jette study helped to reiterate that. But by now the traditional body-building approach had taken its hold with many trainers working with older adults. Get on a leg press, leg extension, chest press, seated row, etc. and work to build muscle.

The results of this study show that exercise has a Very Strong impact on impairment level factors such as muscle strength, flexibility and cardiorespiratory endurance. This makes perfect sense. There is a lot of evidence to show that an older adult can improve their endurance through aerobic training and improve strength through resistance training, etc. However, do these improvements lead to improvements in function? Not as much. The authors noted that the evidence was more inconsistent. This is where the disconnect occurs. If all of these fitness factors are improved then function has to improve right? This data suggests that the connection isn’t as strong as we thought. They also found no evidence that exercise will prevent disability but the authors note that there really aren’t many studies that looked at disability and therefore interpretation was difficult.

A potential downside to this study is that it included exercise studies of all types – aerobic, strength, flexibility and combination programs and we all know that these will not all have the same effect on function. Which leads us to the next bit of evidence.
Just a few years later Latham conducted a review of progressive resistance training (really the gold standard of training) and its effect on function. It only included randomized controlled trials (again the gold standard of research) with subjects aged 60 and over. Like Keysor and Jette, Latham reported an incredible effect on muscular strength. Not surprising. The surprising finding was that the effect of PRT on functional ability ranged from small to, at the most, moderate. AND those individuals that gained the most strength were not necessarily the ones that gained the most function. Is this surprising? It is to many.

What we have to do is figure out why these results are so. Why doesn’t significant increases in strength lead to significant increases in function? After all strength is vital to getting out of a car, walking up stairs, lifting groceries, playing sports and just about everything else. The authors provide a little insight into this dilemma by mentioning that strength is not the only factor involved in functional movement. And they couldn’t be more right. The undue focus on sarcopenia over the past dozen or so years has taken our eyes off of the multi-factorial nature of function. The reality is that most functional tasks require some muscle strength in many muscle groups including prime movers, secondary movers and stabilizers. While typical PRT programs improve strength in the major muscle groups few seldom are able to focus on all of the muscle groups used during functional activities. There are also a number of factors other than muscle strength that are important as we will discuss next.


- Pooled data from 62 trials
  - Randomized controlled trials
  - PRT with subjects aged 60+
- Large positive effect on muscular strength
  - Older adults can get a lot stronger using PRT
- Small to moderate effect on functional ability
  - Strength gains do not equate to similar functional gains
  - Take home message: Stronger is NOT always better!
- No evidence of an effect was found for physical disability
Understanding the disablement model can help you understand the role of muscle strength in function and the results of the Latham review we just looked at. This model is going to describe a process that someone might go through as they get older. In the original model the process begins with active pathology (disease) such as ones we identified earlier (arthritis, cardiovascular disease, diabetes, etc.). The model was revised by Rikli and Jones to include physical inactivity. Disease and inactivity are related. A person who is inactive has an increased risk of developing a chronic condition. Conversely, a person who has active disease is more likely to be physically inactive. A decrease in physical activity can lead to a worsening of the disease condition. It can become a vicious downward cycle which may lead to the next step in the disablement process.

Consider Martha, a 68 year old retired administrator with osteoarthritis in her knees. Her arthritis has progressed over the past 10 years so that it is very uncomfortable for her. Although she used to engage in a number of physical activities she has gradually become less active due to her arthritis. Of course as she decreased her activity levels her arthritis worsened which in turn made her less active which then... well you get the picture.
Over time physical inactivity and disease lead to an impairment. Impairment level factors include all of the things that exercise professionals like to measure – muscle strength, range of motion, cardiovascular endurance and speed. For anyone trained in fitness it is easy to understand this connection. If a person of any age leads an inactive lifestyle the result is a poor level of fitness – weaker muscles, poor cardiovascular endurance, poor flexibility, etc. Disease can also have a direct impact on fitness parameters as well. Consider Martha again. As her arthritis worsened and her activity levels decreased her fitness levels plummeted. At first the changes in fitness weren’t really noticeable by Martha so she didn’t realize how serious her situation was becoming. This is typical of individuals who do not exert themselves much. Therefore they are not fully aware that their physiological reserves are declining. This, of course, is exacerbated by the aging process.
If these impairment level factors continue to decline then the functional capabilities of the individual will be affected. At first, more complex and challenging activities such as heavy work and sporting activities will be affected but if left unchecked even basic daily activities such as climbing stairs, walking, cooking or even bathing could be affected. There are a number of ways that this can happen. If one impairment level factor is drastically reduced then that will affect function. For example, if grip strength alone declines (impairment level) then the individual will have difficulty grasping objects such as pots and pans (functional limitation) required of the daily task of cooking.

Again, consider Martha. Although she has experienced general declines her leg muscles specifically have become weakened from the arthritis so that she is now having difficulty climbing stairs, stooping and lifting heavy objects.

However, sometimes there isn’t any one specific limitation but rather it is the accumulation effect of milder declines in many areas that combine to limit function. The rate of decline and the areas that are affected vary due to age, gender, disease processes and many other factors.
The last stage of this model is disability. Disablement can be defined in a number of ways but is typically a social designation. When an individual can not fulfill their socially-defined roles – mother/father, employee/employer, volunteer, caregiver, etc. – then they are considered disabled. So it is the nature of the functional limitations and the kind of social roles that an individual performs that determine whether or not someone reaches the designation of being disabled.

If Martha can no longer be the caregiver for her ailing husband because she cannot perform the duties required of that “position” then she is considered disabled.

But more than that is the decline in quality of life that will occur. Think about something that you really enjoy doing right now in your life. For me its playing with my kids – football, basketball, soccer, baseball, throwing them in the air. Now imagine you can no longer do that thing. I don’t know about you but I would be devastated. Yes I do know. You would be devastated too.

This is about more than just what a person is able to do or not do. It is about living the kind of fulfilling life that they want and deserve.
Function and Mortality

**Prognosis: Loss of daily functional capability reflects greater risk of death**

- Increased hospitalizations
- Increased nursing home placement
- Predictors of higher mortality rate
  - Male gender (2 points)
  - Age 75-80 (1 point)
  - Age >80 (2 points)
  - Dependent bathing (1 point)
  - Dependent shopping (2 points)
  - Difficult walking (2 points)
  - Difficulty moving heavy items (1 point)

Kind of a no-brainer but important to consider.
Conclusions

- Aging affects a number of inter-related physiological systems which can lead to functional limitations and potentially disability.
- Traditional exercise training techniques provide a plethora of health benefits to the older adult, but they may not optimize functional capacity.
- Therefore, new training paradigms must be created, evaluated and employed.

So here is the punchline for me after taking all of this kind of information and evidence into consideration (and of course there is much more than what I have had time to include here). The common strategy of “basic” exercise training to increase strength is not adequate to really maximize function. There is a lot of exciting new research going on in this area. Scientists are now looking even more into these issues but some of the evidence, as we will see, is still limited and we have to use some powerful deduction based on our knowledge of aging and function in order to create program strategies that we feel will be effective.
Essential Functional Concepts

Cody Sipe, PhD, CES, RCEP
Dan Ritchie, PhD, CSCS

We’re now in the “in between”. We have an understanding of the disablement process and factors that are important in it. We want to get to designing effective exercise interventions to enhance function and avoid disability. But before we can get there we need to explore some important concepts related to function.
Discussing what is and isn’t functional is rather en vogue right now. Wherever you go “expert” trainers are telling you what to do and what not to do. My personal opinion is that there are very few exercises that are not “functional” in some capacity or to some degree but I believe that my opinion is backed up pretty well by the evidence. On the flip side we must be careful about liberally embracing all of the newest ideas without careful analysis.

As a fitness professional we should be able to evaluate, design, implement and assess instead of merely regurgitating what others are suggesting. It is the class difference between giving a trainer a fish and actually learning how to fish. Unfortunately many trainers prefer to take the easy way out.
My preference is to consider exercises along a functional continuum rather than a simplistic “is” or “isn’t” approach. I believe this is a more realistic reflection of exercise and its influence on function.

At its most basic we can view exercises as being more or less functional. To be general exercise movements that are of the isolated, single-joint variety are going to be on the less functional end of the continuum. Exercise movements on the more functional end of the continuum are typically integrated and multi-joint.
This is a simplistic view of isolation-based training but rather accurate nonetheless. Many of the equipment, techniques and program design strategies that we use are steeped in this kind of thinking even if we don’t recognize it or intend it to be that way. As we learned from the data on exercise training and function just focusing on these isolated variables will not lead to optimal improvements in function. Let’s not throw the baby out with the bath water though. This type of training does help people. It builds muscle, improves body composition, helps with disease prevention and management, improves self-esteem, etc. However, the point I would like to make is that there are also limitations to this approach and there may be more effective and efficient ways of training.
The integration approach is quite different. The focus is really on the end result that we are after – improved human movement and function. This takes advantage of how the neuromuscular system is designed to work in the first place which is in a highly coordinated manner. Very, very rarely do muscles work in complete isolation or anywhere close to it. While one muscle group is contracting concentrically another is contracting eccentrically while yet many more are working isometrically to provide joint and whole-body stability. Trainers mentored and educated in corrective exercise techniques will understand and appreciate this difference.

In order to really implement integrated approaches the typical sets and reps approach must be re-evaluated. Actually just throw it out the window. Because one of the main points of emphasis is on form and working through time, sets or reps while maintaining proper form. Like a weak link in a chain there will be one or more areas that fatigue sooner than others that will cause a break down in form. It is important to find out when that occurs. One person may have a form-fault at 8 reps while another at 25 reps and likely due to different reasons. Simply having someone complete 3 sets of 12 reps is a poor qualitative approach. We learn a lot from when and how a person breaks down during repeated movements.
The research supports this idea that focusing on increasing muscle strength in individual muscle groups has limited benefit for most individuals. Those who are the most frail and weakest will benefit (functionally) from isolated strength training because strength is the primary area of deficit for them. This is evidenced by the landmark Fiatarone and Singh nursing home study and by research from Westcott et al. Like I said before, we don’t want to throw the baby out with the bath water. However, for the majority of older individuals who have not yet experienced debilitating sarcopenia a more robust approach has much merit.
Unfortunately trainers typically short-change function by focusing mostly or even exclusively on the items in the left-hand column. And sometimes not even all of those. Function is complicated. I have reservations saying that I am a “functional expert” because I know that there is still so much more to know about function. It is humbling in many regards because after years of study I recognize that I have barely even scratched the surface.

If we want to really dramatically improve functional capabilities then we must have a larger view of function and a greater understanding of its components. Dan trained an older male client with Parkinson’s disease who had incredible leg strength on the leg press. In fact, he could readily press the entire stack of about 420 pounds during his workout sets. He definitely did not lack strength in his legs. BUT he could barely walk into the center and relied very heavily on his cane, often stopping for several seconds to regain his balance. To me this is a great example of how strength is important but not everything when it comes to function.

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<th>What are the components of function?</th>
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<tbody>
<tr>
<td>• Muscular Strength</td>
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<td>– Concentric</td>
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<td>– Eccentric</td>
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<td>– Isometric</td>
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<td>• Speed (Contractile Velocity)</td>
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<td>• Muscular Power</td>
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<td>• Aerobic Power</td>
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<tr>
<td>• Mobility</td>
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<td>• Agility</td>
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<tr>
<td>• Balance</td>
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<tr>
<td>• Stability</td>
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<td>• Gait</td>
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</tbody>
</table>

If there are so many components of function then why do we only focus on strength?
Even some relatively “simple” tasks have a lot more going on than we recognize on the surface.

**Example: Climbing a flight of stairs**

- Quadriceps
  - Strength
  - Power
- Hip flexors
- Calf
  - Plantar flexor power
  - Dorsiflexion
- Ankle stability
  - Proprioception
- Lateral stability through core
  - Abdominals
  - Hips/pelvis
  - Back
- Somatosensation
- Endurance
  - Local muscle
  - Cardiorespiratory

**This “simple” task requires a lot more than just strength!**
Getting out of a car

Break down this typical daily task into its primary movement patterns.

What is required: muscle usage, biomechanics, components of function, planes of movement, etc.?

A task such as getting out of a car is even more complicated because it requires the core and upper body much more and requires turning. Break down this task into its components. Be as specific as you can possibly be. Refer back to the list of the components of function if you need to.
One of the many perspectives that I like to promote is this concept that we aren’t training muscles we are training the neuromusculoskeletal system. Our goal is to get these three systems to work in a highly coordinated and effective fashion so that functional tasks are completed successfully. There is an extremely important distinction to be made here. The isolated approach is really best for simply training muscles so that they get bigger and stronger. The integrated approach is best for improving the efficacy and efficiency of the neuromusculoskeletal system.
Consider this example.

We typically train the “core” using these exercises or variations of them. We know that they will strengthen the rectus abdominis, obliques and (maybe) the transverse abdominis.

However, when we really evaluate how our core works in real life we see that there are very few movements in which our pelvis is stabilized by a floor or wall. Getting out of bed in the morning maybe….

So although abdominal strength is helpful to a certain degree do these movements match up with or prepare the body adequately for daily demands? No.
So it is time to get out of the one-dimensional box and start to think and train four-dimensionally. Remember that we live in three dimensions – the sagittal plane (front and back); frontal plane (side to side) and transverse plane (rotation).

The fourth dimension is achieved when we combine 2 or all of the 3 planes of human movement simultaneously. For example, a one-arm standing chest press (a personal favorite of mine) requires stability in both the sagittal and transverse planes for the core and sagittal chest strength. Would this be the best approach for maximally improving chest strength and size? No way. The bench press or DB bench press are both much better. But do most of us usually find ourselves with our back to a wall or floor pushing something? Maybe moving furniture away from the wall but typically no. However, we much more often find ourselves pushing on something without any support. Pushing a lawn mower that is stuck. Opening a heavy door. Pushing a car that has run out of gas (been there, done that way too many times!). So while some chest strength is required the force is transferred down the body to create a ground-reaction force. Therefore the chest is used in combination with core stability and dynamic leg strength (gait cycle). Without these other two it really doesn’t matter too much if you can bench press a horse.
So what is a better approach to “functional” training?

- Challenge the neuromuscular system by utilizing movements that require muscle groups to work together
- Challenge the body in similar ways to how it is challenged in daily life
- Include 3 (and 4) Dimensional Movements
- Challenge many components of function simultaneously
What are the advantages to this kind of functional approach?

- Injury Prevention: Exposing the weak links
- Rehabilitation: Preparing for real-life demands
  - Back problems, osteoporosis, joint replacement?
- Enhanced athletic performance
- Trains muscles “I never knew I had”
- Workout Efficiency
- Increased caloric expenditure
- Mitigates boredom
- Cheaper equipment
- Smaller footprint
- TRANSLATES TO BETTER FUNCTIONAL CAPACITY!

I could really go on for days about the numerous advantages that the integrated functional approach has over the traditional isolated methodology. I chose to not bore you with even more scientific evidence but there is a growing amount of literature supporting what is often referred to as multi-modal or functional training. While the bottom line for me is that it has great potential for functional improvements these other benefits I have listed are also nice. I can personally attest to the “mitigates boredom” point. People get bored with their exercise routine quite quickly in my experience. The functional approach opens up so many doors of possibility that the variations are virtually endless. People just end up more focused during the routine so time passes quickly and they (dare I say it) actually have fun. Being an educator, even when training clients, I also love all of the opportunities for teaching, explaining and demonstrating. It doesn’t take too much concentration or skill for the average person to master the leg extension but it takes plenty of both to master the one-legged front lunge with one-arm overhead DB press.
So let’s put all this together into some basic principles that can guide our exercise programming efforts.

These 7 Principles are my own creation but based on both the evidence and my experiences. They are rather self-explanatory and hopefully pretty easy to follow. The question you must ask yourself is “How can I implement these principles into my training programs?”.

### 7 Principles of Functional Training for Older Adults

1. Train all components of function
2. Have a purpose
3. Standing when possible
4. Isolation movements as supplements
5. Energy level to order session
6. Integrate movement patterns
7. Maximize safety and success
7 Principles for Functional Training Older Adults

1. Train all components of function
   a) Can’t do it on traditional isolation machines.
   b) The trainer needs to become more adept at covering a wider range of components over the course of the training program.
   c) Identify which components are deficient (objective testing is best) and prioritize those in the training program.
   d) Seldom do we focus on training a muscle (unless it happens to be a weak link)
7 Principles for Functional Training Older Adults

2. Have a purpose
   a) Don’t include an exercise unless you can justify its benefit (functionally) for the client.
   b) All movements should lead towards the desired outcomes (be specific)
   c) Don’t just do stuff to fill a void or because you want to try out something new
   d) Wield a scalpel, not a hatchet.
   e) Use short and long-term goals to determine movement selection and progressions
7 Principles for Functional Training Older Adults

3. Do as many exercises standing as possible
   a) Standing utilizes a larger degree of muscle groups
   b) It creates ground reaction forces, challenges balance and uses the core muscles for stability
   c) The majority of daily tasks that place a large demand on the body occur while standing
   d) Ambulation is a key to maintaining independence
   e) Sitting in a supported position allows the rest of the body to “take a break” while you isolate a muscle group – something we are trying to avoid
7 Principles for Functional Training Older Adults

4. Include isolation exercise movements as supplements
   a) Isolation moves are great when a client has a strength deficiency in a particular muscle group
   b) Can also be used as a way to break down a more complicated movement into smaller steps and have them prepare for it
   c) Should not be the core of the program
   d) Should be performed at the end of the session
7 Principles for Functional Training Older Adults

5. Order the session according to energy level
   a) Clients’ energy levels will wane during the session
   b) Perform the more complex, higher intensity and cognitively demanding movements at the beginning of the session
   c) Allow enough recovery time between sets but decrease rest time as they progress
   d) Perform seated and isolation movements at the end of the session
   e) For many clients 30 min sessions will be enough
7 Principles for Functional Training Older Adults

6. Integrate movement patterns ("Train in all 3 planes")
   a. “Tweak” isolated movements they have been performing to become more functional by making them multi-planar
   b. Most of your functional movement patterns should use 2 planes; more complex patterns will use 3
   c. Progress methodically from 1 to 2 to 3 planes allowing your client to successfully learn the motor patterns before making it more complex
7 Principles for Functional Training Older Adults

7. Maximize client safety and success
   a. Continually monitor client for signs of distress
   b. Do NOT progress a client until they can perform the movement with close to 90% accuracy
   c. Allow them time to adapt before progressing
   d. Use unstable surfaces with discretion
   e. Always guard against a fall
   f. Seek their feedback often
   g. Perform complex movements in an open area where they have plenty of room in case they stumble or fall
I have done a lot of investigation into the use of unstable or labile surfaces and its benefits for clients of all ages. I have even given several presentations on the topic at conferences. Despite their widespread use the evidence just does not support their use for everyone. In fact some evidence I have found suggests that it might impair performance for some athletes.

Where we clearly see its use indicated is for ankle injury therapy and balance-specific training (vestibular and somatosensory).

If I ever see you squatting on a physioball I am going to walk up and slap you…so don’t take it personally.
Function. It is one of the most important driving forces for older adults and one that we will talk a lot about even more. But to me it all starts with a good assessment that can reveal deficits in human movement and provide us with valuable information for designing interventions.
Unfortunately many trainers really skimp on assessments and especially for older clients. For starters the PARQ is only valid up to age 65 so it really does no good using it on clients older than that. But even for 55-65 year olds it isn’t the best tool because it really doesn’t provide you with much useful information. The best thing to do is conduct an in-depth health history interview. This means actually asking the client specific questions about their current and past health conditions. That way you can get both quantitative and qualitative information that will be very valuable in setting up their training program.

**Screening & Health History**

- PARQ is inadequate for screening older adults
- Comprehensive health history interview is highly recommended
  - Current health conditions
  - Past medical problems
  - Medications and supplements
  - Signs and symptoms of CVD
  - Activity level, goals, concerns
- Informed consent is a must for testing and training
Then of course you should conduct an individualized battery of physical assessments. It is best to rely in assessments that have been used in the clinical and research literature and that have norm or scoring tables with them. That way you can rest assured that the measurements can be interpreted appropriately.

Following are descriptions of a number of assessments from the Senior Fitness Test Battery that are useful for any trainer of older clients. All of them can be performed with very minimal equipment and require very little skill on the trainer’s part. Plus they have all been used extensively.

I have not included any balance-specific assessments here (although several of these have been related to balance) but have reserved those for the Breakthrough Balance Training manual.
Senior Fitness Test Battery

- Chair Stand
- Arm Curl
- 8’ Up and Go
- 2-min Step in Place
- Chair Sit and Reach
- Back Scratch

This is a great, low-cost and easy to implement test battery that has been designed specifically for use with older adults.

Purchase the manual below for detailed instructions on how to perform the tests properly.

!WARNING!

Do NOT perform these tests without purchasing the manual and learning how to perform and score them properly using the validated scoring tables.

The information on these test items included here is NOT intended to be complete.

Remember, the main source of error during assessments is due to the tester.
SFT Chair Stand

• Assesses lower-extremity strength under practical (functional) conditions
• Validated against 1RM leg press
• Basic Instructions:
  – Have client sit in a standard height chair with arms folded across chest
  – Count the number of times they can rise from a chair in 30 seconds
SFT Arm Curl

• Assesses upper extremity muscular strength
• Basic Instructions:
  – Have client sit in chair with dumbbell in dominant hand
  – Count the number of times they can “curl” a weight while seated in a chair
  – Use 5lb for women; 8lb for men
SFT 2-min Step Test

- Assesses cardiorespiratory endurance
- Validated against maximal VO2 testing
- Basic Instructions:
  - Have client stand beside a wall
  - Measure halfway between hip and knee
  - Mark that height on the wall
  - Count the number of steps they can make in two minutes (only count right leg)
There is also a Timed Up and Go (TUG) test that is widely used. These two are not the same as the distances are a little bit different and so the scoring norms are different as well.

SFT 8 Ft. Up & Go

- Assesses mobility and dynamic balance
- Basic Instructions:
  - Have client sit in chair with a cone placed 8’ from front edge of chair
  - Time how long it takes them to rise from the chair, walk around the cone and return to their seat

- NOTE: In one study, older adults who required greater than 8.5 seconds were classified as fallers (82% prediction rate)
Okay, so let’s get down to some examples of exercise movements that meet our criteria of integrated training. These are pulled from lots of different sources and experts (Gary Gray, Gray Cook, Lee Burton, Stuart McGill, Rodney Corn, etc.) including my own perspectives.
### Manipulations to Increase the Functionality of Traditional Exercise Movements

- **Body Position**
  - Prone
  - Supine
  - Kneeling
  - Half-Kneeling
  - Seated
  - Tandem
  - Semi-tandem
  - Lunge
  - Plie
  - Single Leg

- **Equipment**
  - Tubing
  - Dumbbells
  - Medicine Balls
  - Ropes
  - Bodyweight
  - Cables
  - Aquatics
  - Sandbags
  - Kettlebells
  - BodyBlade

Part of the Gray institute’s functional nomenclature.
Manipulations to Increase the Functionality of Traditional Exercise Movements

- Movements
  - Hand position
    - Pronated
    - Supinated
    - Neutral
    - Mixed
  - Hand and Foot
    - Bilateral
    - Unilateral
    - Reciprocating
    - Alternating

- Movements
  - Plane
    - Frontal
    - Sagittal
    - Transverse
    - Combination
  - Angle/Direction
  - Speed
  - Muscle Activation
    - Concentric
    - Eccentric
    - Isometric

Part of the Gray institute’s functional nomenclature.
I just love progressions (and regressions when necessary). Here are two basic examples of how to move towards functional integration starting with a traditional isolation movement. Let’s break down the row progression really quickly and see what’s happening.

Seated Row: Torso is stabilized by a chest pad so very little core or hip/glute complex activation is needed. The mid-traps, lats and rhomboids can be stressed and developed maximally because of this externally stabilized position.

Standing Row with Cables: The move to a standing position now creates a ground reaction force and requires core stability, hip/glute activation and leg muscle activation in the sagittal plane. The foot position determines whole-body sagittal plane stability with a staggered stance creating more stability. Whether the traps/lats/rhomboids can be worked maximally will depend on the ratio of their strength to the stabilizing capability of the rest of the body.

One-Arm Standing Row: Moving to a one-arm row now changes the force activation pattern for the core. While there is still a strong sagittal plane component there is also a strong stabilizing transverse plane demand due to the unbalanced force pattern. The foot pattern is also important. An ipsilateral position (same foot and hand forward) will create a different loading scenario than a contralateral position (opposite hand and foot forward).

One-Arm Standing Row in Lunge Position: Dropping the center of gravity increases sagittal stability and activates the hip/glute complex more.

One-Arm Row with Full Lunge: The movement now becomes dynamic which requires a more highly coordinated activation of motor units. Instead of the legs working isometrically to provide stability they must now contract concentrically and eccentrically to propel the body through space. Acceleration, deceleration, power, ankle stability, etc. now become important components.

One-Arm Row with Full Lunge and Torso Rotation: The added rotation changes the transverse plane demand from one of isometric stabilization to active eccentric and concentric contraction.

Take the chest press progression and explain the differing demands on the body just as I’ve done with the row progression.

<table>
<thead>
<tr>
<th>Sample Progressions to Increase Functional Demands</th>
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</thead>
<tbody>
<tr>
<td><strong>Row Progression</strong></td>
</tr>
<tr>
<td>• Seated Row</td>
</tr>
<tr>
<td>• Standing Row</td>
</tr>
<tr>
<td>• Standing row with cables</td>
</tr>
<tr>
<td>• 1-Arm standing row</td>
</tr>
<tr>
<td>• 1-Arm standing row in lunge position</td>
</tr>
<tr>
<td>• 1-Arm row with full lunge</td>
</tr>
<tr>
<td>• 1-Arm row with full lunge and torso rotation</td>
</tr>
<tr>
<td><strong>Chest Press Progression</strong></td>
</tr>
<tr>
<td>• Dumbbell Bench Press</td>
</tr>
<tr>
<td>• DB Bench on Stability Ball</td>
</tr>
<tr>
<td>• Standing chest press using cables</td>
</tr>
<tr>
<td>• Standing 1-arm chest press</td>
</tr>
<tr>
<td>• Standing 1-arm chest press with torso rotation</td>
</tr>
<tr>
<td>• Standing 1-arm chest press with opposite arm row</td>
</tr>
<tr>
<td>• Add torso rotation</td>
</tr>
</tbody>
</table>

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Chop and Lift: Cables or Tubing
As recommended by Gray Cook, PT

- Half-Kneeling Chop: Leg to machine is forward
- Half-Kneeling Lift: Leg to machine is back
- Postural variations
  - Seated on Stability Ball
  - Kneeling (both knees on floor)
  - Standing
    • Add step

There are multiple ways to perform chops and lifts. I won’t explain all of them here but a key difference is whether or not the person stabilizes the torso to resist any movement or the person twists the torso through the movement. I use both methods with individuals depending on their situation, health history, goals and level of performance.
These are a few of the functional core/abdominal exercises recommended by Gary Gray. I have used all of these with individuals with varying degrees of success. The dumpouts need to use light weights otherwise there is considerable strain on the individual's back. Same goes with the opposite over-shoulder reach.

**Core Sequence**

As recommended by Gary Gray, PT

- **Dumpouts**
  - DB's at shoulders; lean back and “dump” 1 DB over shoulder; return to start; repeat other side
- **Uppercuts**
  - Similar to a boxer’s uppercut punch using a DB, band or pulley
- **Opposite Over-Shoulder Reach**
  - DB’s at shoulders; lean back while twisting to one side; reach over back shoulder with DB in opposite hand; return to start; repeat other side
Instead of trying to “isolate” the core which is a big mistake in the first place is to challenge the individual's core stability during a variety of static and dynamic movement demands. Lunges provide a great environment for standing core work and can be performed at varying degrees of step length, depth, direction, speed and surface demand. However, it is imperative that there is a huge emphasis on performing these movements with proper form and observing for form-faults as the client performs repetitions.

I love the power punch with cables which I “invented”. What I mean is that I came up with it for my own clients although I have no doubt whatsoever that this has been used by many other people before me. The reason I love it is because it involves multiple planes of motion and requires dynamic movement. Plus my clients love it as well because we have a lot of fun with it.

If you are thinking that these movements don’t appear to be much different than what we would do with a younger client then you are right. As I’ve emphasized before, just because someone is older doesn’t mean that they needed to be treated with kid gloves. There is a more complicated layer of information that must be considered, however, that the younger client won’t have. This layer includes disease conditions, atrophy, lack of muscle control, joint irritations, past injuries, etc.
Motor control and coordination are HUGE areas of concern that we absolutely need to address. To challenge these you need to think about requiring movements that are more complicated to perform. You may have noticed that even adding an upper body movement to a lower body movement will throw many older clients for a loop. They struggle to stay in sync and keep a rhythmic movement. This shows that they really need help with motor control. These exercise movements represent just a few of the examples of how to challenge them appropriately.

One tip is to start simply and let them master it before adding the next layer of complexity onto that movement. That way you will build their self-efficacy and confidence. They will then feel more comfortable adding another task to that movement.

When first learning the movement they may need to concentrate fully on the task but as they get better you will see them relaxing more and maybe able to engage in light conversation during the drill.

One of my favorites is the What Time Is It? drill which I adapted from the FallProof balance training course I took. Have the client imagine they are standing in the middle of a clock face which is on the floor. 12:00 is in front of them. 3:00 is to the right. 6:00 is directly behind. 9:00 is to the left. And all of the other numbers are in between. You call out a time and they either step or lunge to that number (depending on their strength and skill level) and then return to standing. As they get better you can speed up calling the numbers, add simultaneous upper-body movements, have them use only the right or left leg, etc. The variations are endless and fun. Clients love the thinking part of this because as you speed up they have to process the number you called with where that number is spatially and then initiate the appropriate movement. What a great mind-body connection.
Monitoring Clients

• Form, form, form!
  – Monitor for compensation patterns
• Throw sets and reps out the window
• Ask the right questions
• Interpret body language
  – Facial expressions, breathing pattern
• Don’t progress to a more difficult move until they have mastered an easier one
• Be very careful of orthopedic conditions
Functional Exercise: Advanced Concepts and Techniques

Cody Sipe, PhD, CES, RCEP
Dan Ritchie, PhD, CSCS
Functional Exercise: Advanced Concepts and Techniques

- Power Training
- Functional Periodization
Have you played tennis, golf, basketball? Have you had to quickly climb a flight of stairs because you were late to an appointment; stumbled while walking and had to keep yourself from falling flat on your face; quickly stepped to the side because something was about to run into you? At some point you’ve done at least a few if not all of these. Therefore, you already have a working knowledge of muscle power. Power is simply force multiplied by velocity which we also refer to as explosive strength.

If you were to stand up, keep your hands to your side and jump as high as you can then what is going to determine how high you jump? It is the velocity that you generate before leaving the ground. The faster your body is moving upwards the higher you will go. Is that dependent upon the strength of your lower-body musculature. Yes. It is totally dependent on strength? No.

Shot is 16lbs
Snatch is 330 lbs

So the shot put, although much smaller and lighter, generates 60% more power than the snatch. Who would have thought? But remember this idea as we go through this information on muscle power because it is critical to understanding how to train older clients appropriately for power gains.
Because muscle power is a function of both strength and velocity and both of these decline with advancing age then it shouldn’t be any surprise that muscle power declines earlier and more sharply. Because of this, it is very likely that muscle power is significantly compromised in many older adults even if they have only experienced typical declines in muscle strength.
And here we see why. These are arbitrary units but they make the point. If strength and muscle velocity only decrease by 30% (which is a conservative estimate based on the aging literature) then the impact on muscle power is huge. Power drops by half.

Muscle strength decreases 1-2% per year in the lower body musculature beginning around age 50 with a significant degree of individual variability.

There are four main factors that contribute to the decline in strength – muscle atrophy (sarcopenia) of 20-40%; changes in muscle fiber characteristics (preferential atrophy of type II – fast-fibers); changes in the nervous system (loss of motor units of 1% beginning in the third decade and increasing in rate after 60 years of age); changes in muscle blood flow (decline in capillarity).

Contractile velocity decreases significantly as a result of these same factors. It is rather logical that velocity would decrease because of the force:velocity relationship. As force, or load, increases velocity decreases and vice versa. Therefore, if maximal strength declines then velocity at any given absolute submaximal load will also decrease.

Since power is dependent upon strength and contractile velocity and both decline with aging we see power declining earlier and more precipitously than either. In fact, power declines at a 10% greater rate per decade than does strength although some have suggested that after the age of 60 the loss of power is accelerated, perhaps as high as 3.5% per year.

Of course there are a number of age-related declines that add complexity to the picture including reaction time, postural control, motor control, coordination and cognition.

Does this matter?
Yes it matters because many activities of daily living require power not to mention all of the recreational and sports activities that rely heavily on the generation of muscle power.
Results:

Leg Power accounted for 2% to 8% more of the variance with all measures of physical performance.

Translation:

Leg power is more important than muscle strength for performing many activities of daily living such as climbing stairs, walking and task completion. So while we have been so concerned with the loss of muscle strength it appears that we should be more concerned with the loss of muscle power.
More evidence to show how important power is to functional capacity and to show that power training might be just what the doctor ordered for improving functional outcomes. There are a lot of studies that were included in this review indicating that power training is superior. Unfortunately the training methods and assessments used varied tremendously so it was really difficult for the authors to make any foregone conclusions.


- Muscle power is highly correlated with function (ADL)
- Varying training programs make direct comparisons difficult
- Continued investigation into the beneficial effects of power training is needed
- **Conclusion:** Power (high-velocity) training may be more effective/optimal in improving function
These studies used a variety of training methods and equipment. Some low budget. Others high dollar. My facility uses Keiser pneumatic resistance equipment and we absolutely love it for power training. However, we also use a variety of low-budget equipment as well. It is difficult to tell which one is superior at this point and it is likely that it depends on the muscle group being utilized and the functional tasks being trained for.
Power Movements

• Vertical Jumps
  – Full squat
  – ¾ squat
  – No calves

• Power Pushups

• Lateral jumps

  Use soft mats for jumping movements
  Teach proper landing mechanics
  Discontinue if joint irritations develop
Lower-Body Power Movements

**No Equipment**
- Quick Stationary Lunges
- Speed Walking
  - Change of Direction
- Lateral Shuffles
- Bug Stomp
- Faux Falls
- Around the Clock
- Ready, Set, Go!
- Bunny Hops

**Basic Equipment**
- Ladder Drills
- Step-ups
  - Front, Side
  - W/ knee up
- Side step-ups
- Directional steps w/ loop
- Hip Flexion w/ tube
- Band Release Fall
- Seated Ball Kicks

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Focus must be on movement speed
“As fast as you can” while maintaining good form and safety
A Powerful Prescription

• 2-3 sets, 6-10 reps, 2-3 days per week
• 20-70% 1RM
• Concentric performed “as fast as possible”
• Eccentric performed at 2-3 seconds
• Appropriate equipment selection is critical
• Major focus on lower-body musculature and mobility activities
• Do you need to build a strength base first? No

MORE RESEARCH IS NEEDED TO BETTER DEFINE POWER TRAINING RECOMMENDATIONS
I need to thank the Dennis Keiser and the Keiser Corporation for letting me use this graph from their lab. It shows that when you do a leg extension (I apologize for using a picture of a leg press when in fact the data is for leg extension) on a traditional selectorized unit there are some serious concerns for power training.

Focus first on the red graph lines which represents the selectorized unit. If the repetition is completed over a period of 8 seconds (that is very slow, try it) then the force curve looks really good but that kind of slow speed isn’t going to work for power development. If the repetition is completed in 2 seconds (which is more in line with power training) the force curve is disrupted. There is a much larger force required at the beginning of the movement when the knee is in flexion (not a good thing for joints especially arthritic ones). But by the end of the movement there is a much smaller force due to momentum (the weight is moving all by itself). So too much force at the beginning and not enough at the end. If the rep is completed in 1 second (even more optimal for power training) the force curve is disrupted even further with huge loads at the beginning and hardly any load at all at the end of the movement.

Now focus on the blue graph line which represents the Keiser pneumatic unit. You see that the force curve looks really good and is very similar to the 8 second repetition. However, the reality is that the blue line includes 8, 2 and 1 second repetition speeds. At increasing speeds the force curve does not change because the resistance is not gravity based and therefore there is no inertia or momentum to contend with.

There are two take-home messages here:

1) Selectorized equipment is NOT the best choice for power training and there are some serious concerns for joint health.

2) The Keiser pneumatic equipment is an excellent choice because the force curve stays the same no matter how fast the individual moves.

We must consider and address the problems of inertia and momentum with whatever equipment we use.
Proper Exercise Selection for Power Training Dependent On:

1. Functional abilities of client
2. Co-morbid/injury considerations
   a) If they have knee osteoarthritis then no leg extensions; be careful with leg press
   b) Osteoporosis: must protect posture and reduce spinal load
3. Functional goals
4. Available equipment
5. Training environment
6. Trainer’s expertise and experience
While the majority of power development with older clients should focus on the lower-body in order to maintain or improve mobility and balance we must not forget the upper body and especially the core (for stability more than power).

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**Upper-Body Power Movements**

- **Med Ball**
  - Kneeling Shuffle pass
  - Standing chest pass
  - Standing overhead bounce pass
  - Squat throws overhead

- **Power row**
  - All angles
- **Power row with lunge**
- **Power punches**
Training Tips

- Educate yourself regarding the safety and efficacy of the movement
- Affirm appropriateness for each client
- Assess client’s comprehension
- Ensure a safe environment
- Follow recognized motor learning principles and techniques
- Continually solicit feedback and listen well
This is just a very brief introduction to this concept which Dr. Signorile goes into much more detail about in his book “Bending the Aging Curve” (Human Kinetics).

You may already be familiar with periodization schemes for athletes but what about for older adults? The basic idea here is to first focus on some of the basic components of fitness such as strength, power, endurance, etc. in the first cycle and then transition over to focusing on integrating movements and challenging motor control/coordination during the second cycle. Begin and end with proper assessment and then repeat these cycles at a higher level.

So build strength and then teach them how to use it functionally.

Functional Periodization Training

- Periodization applied to motor learning principles
- Goal is to turn strength into function
- Resistance training cycle followed by a motor learning cycle
- Intensity of resistance gives way to more complex movements that sometimes mimic daily activities

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So the three variables that are manipulated in these cycles are intensity, complexity and volume.

During the first cycle complexity is kept low, volume is higher and intensity is moderate at the beginning. At mid-cycle complexity is still low but intensity is higher and volume is lower. By the end of the cycle the transition to the second cycle has begun so complexity starts to build while intensity begins to decline.

During the second cycle intensity has dropped so that complexity and volume are moderate at the beginning. At mid-cycle complexity and intensity are high while volume has dropped. By the end of the cycle complexity drops off a bit as does intensity and volume goes back up a little.

Functional assessments are made and the program is redesigned for the second set of cycles.
Challenging Motor Learning

• Add Complexity
  – Single to multi-joint
  – Series of tasks
  – Mimic daily activities
    • Bending
    • Lifting
    • Stooping
    • Transferring
  – Obstacle Course
Final Thoughts

Quit training older clients the same way you train younger clients. Their needs are much more complicated and specific. The evidence clearly indicates that the typical isolated strength training approach will yield limited results functionally. A more robust 4-dimensional approach that includes a large variety of functional components is highly recommended. Individual programs should be based on individual assessment results, conditions and goals. Power training and functional periodization are great new tools to include in your toolbox but should be mastered before being used with all clients.