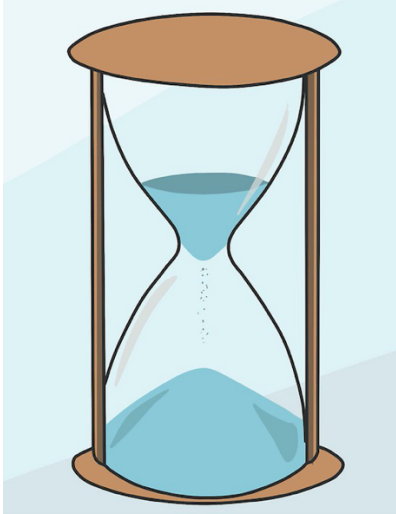


Exercise Program Design

Periodization of Training

When training active older adults it is likely that you will encounter clients who have struggled with nagging injuries for a long period of time which can occasionally (or frequently) hinder their ability to train to the degree they desire and to enjoy their day-to-day lives to the fullest. One's desire to push the limits and continue to improve, even in the face of Father Time is understandable and commendable, but sometimes too much of a good thing (i.e., training) can be a bad thing. This can be addressed by utilizing a non-linear periodized training scheme with your active aging clients similar to that employed for athletes who are preparing for competition. Non-linear periodization varies volume and intensity of exercise throughout the training program with distinct periods of more effort and other periods of less effort and have been found to maximize adaptation to exercise training and optimizing recovery (36). This is meant to enable peak performance for an athlete at the time of competition and reduce the likelihood of overtraining. However, instead of non-linear periodizing training in order to avoid overtraining an athlete, the goal for active agers is to balance the goal of adequately challenging their high level of function with adequate time for adaptation and recovery.



The basics of non-linear periodization include breaking a long-term program (e.g., 6 months), termed a macrocycle into shorter periods (e.g., 2 months), termed a mesocycle. These mesocycles will emphasize different training intensities and volumes (e.g., high vs. low volume, high vs. low intensity) and will then set the stage to vary the challenge of the individual workout sessions (termed microcycles) to accomplish the long-term goal of optimal adaptation. Each domain of fitness discussed below should be modulated over time to properly periodize the overall program. For example, an active aging client who is prepping for ski season in 12 weeks may have a program similar to the table below.

Macrocycle – 12-Week Ski Prep				
Training Domain	Week 1-3	Week 4-6	Week 7-9	Week 10-12
Corrective Exercise	High	Moderate	Moderate	Low
Balance & Agility Training	Low	Moderate	High	High
Resistance Training	Moderate	High	Moderate	Moderate

Cardiovascular Training	High	Moderate	Moderate	Low
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Importance of Preventative Maintenance

Aging brings with it an increase in joint stiffness and a loss of connective and muscle tissue compliance (37). These changes can reduce proprioceptive input to the central nervous system and result in poor sensorimotor integration which can lead to possible injury during a training session. These issues are also implicated in altered gait mechanics and postural distortions with aging.

To complicate matters further, by virtue of being engaged in many pursuits, your active aging clients are at increased risk for musculoskeletal issues such as strains, post-exercise soreness, and overuse injuries. Because they are older people, it takes the musculoskeletal system longer to recover and repair itself after exercise as compared to young and middle-aged adults. This requires added emphasis on preventative maintenance activities that will best prepare your clients for their exercise sessions and facilitate the most effective recovery afterwards.

Therefore, every training session needs to begin with movement preparation exercises. This should include a short cardiovascular warm-up to get the blood flowing to working muscles and increase soft tissue temperature to improve range of motion and reduce injury risk. It is recommended that this be at least 5-10 minutes at a moderate intensity. Following that, foam rolling (or other forms of myofascial release) and

dynamic (i.e., moving) stretching should be performed. Dynamic stretching has been shown to be an effective preparation for exercise (38). Dynamic stretches should be done in multiple planes of motion and include movement patterns that will be used in the upcoming exercise session. Although the specifics of the training session should guide the selection of the dynamic stretches, some appropriate examples include lunges, shuffle steps, leg swings, crawling patterns, rotating punches, lateral trunk bends, shoulder circles and neck rotations. Dynamic stretches should be performed for at least 30 seconds per movement and flow from one exercise to the next. The entire dynamic stretching period should be at least 5-8 minutes in duration prior to transitioning to the remainder of the training session.

Foam rolling and dynamic stretching can also be integrated between sets of exercises or when transitioning from one domain of exercise to another during a training session. Here are some recommendations for foam rolling and dynamic stretching for your active older clients:

- Do not use a foam roller on the lumbar region for older clients with osteoporosis, spinal stenosis, or low back pain. The pressure of the roller can cause injury.
- Do not use a foam roller on the legs for older clients with varicose veins or peripheral artery disease. The pressure of the roller can be painful and may increase vascular damage.
- Do not perform dynamic stretches to the point of pain, instead encourage movement through the available range of motion, which may increase over time.

- Perform dynamic stretches in a logical pattern such as lower body to upper body or large muscle groups to smaller muscle groups. Include rotational dynamic stretches to reduce risk for injury during total body movement patterns.
- Encourage deep and mindful breathing in order to increase oxygenation of blood and body awareness

Also, independent of the training session, your active older clients should be encouraged to spend some time each day to engage in recovery/regeneration strategies to reduce soreness, maintain range of motion, and decrease recovery time. These strategies can include 3 dimensional breathing exercises, foam rolling and other forms of myofascial release, massage, heat/cold therapy, compression therapy, stretching or Yoga/Tai Chi, or meditation/relaxation exercises just to name a few.



Cardiovascular/Metabolic Training

Cardiovascular training has evolved significantly over the last several years, going from long duration/moderate intensity exercise sessions to a current focus on high intensity interval training (HIIT). This domain of conditioning has transitioned from a focus on the health of the cardiovascular system to the overall metabolic health of an individual which encompasses both long-term low intensity and short-term high intensity capacities. This is now often referred to as metabolic fitness. But due to its high metabolic demands, a reasonable question is how much HIIT training is appropriate for active agers.

A recent study by cellular biologists demonstrated the ability for HIIT training to enhance metabolic function in older adults. A sample of older adults and young adults were assigned to one of three training groups: moderate intensity cardio training, moderate resistance training, or HIIT. The young adults showed genetic upregulation of cellular metabolism (specifically the development of new mitochondria) in response to all 3 training groups, however the older adult group saw a massive response only to the HIIT training (39,40) and virtually no genetic metabolic response to the other training modalities. HIIT has also been shown to be well-tolerated by older adults and have fewer medical complications than long duration moderate intensity training. Also, it is fine to integrate moderate-intensity cardiovascular training (MIT) sessions into the overall conditioning program as well. Both HIIT and MIT increase exercise capacity and improve both blood pressure, blood glucose and blood lipid profiles (35,36). Always include at least a 5-minute cool-down following cardiovascular or

metabolic training in order to reduce venous pooling which has been implicated in sudden cardiac events.



It is recommended to perform HIIT or MIT workouts 3-5 days per week. Use heart rate or the RPE scale to monitor intensity during HIIT sessions. Initially, utilize a 1:2 ratio for metabolic and recovery intervals (30-second metabolic intervals and 60-second recovery intervals). As the active ager becomes more accustomed to HIIT in the workout, change the work/rest ratio to 1:1 and even 2:1. Perform 6-8 intervals total.

Metabolic (High Intensity) Intervals	Recovery (Low Intensity) Intervals
85%+ of Max HR	~65% of Max HR
17+ on RPE Scale	~13 on RPE Scale

Here are 3 HIIT paradigms that may be a good fit for your active older clients:

- Treadmill - Perform a 3-5 minute warm-up at a brisk walk or jog, this speed will stay constant during the HIIT training session. Then, increase grade on the treadmill (e.g., 12%) for the metabolic interval (safer than increasing speed where it may get too fast). Return to the lower grade for a recovery interval (e.g., 2%). An elliptical or stationary cycle could be used as well.
- Plyometric Circuit - 1st interval: Sagittal plane broad jumps or box jump-ups. Tandem walking for the recovery interval. 2nd interval: Lateral hops or speed skaters. Sideways step-to-balance for the recovery interval. 3rd interval: Rotating hops or 180-degree jumps. Rotating step-to-balance for the recovery interval.
- Functional Circuit - 1st interval: Mountain climbers from hands, elbows or bench. Choose a dynamic stretch from Movement Preparation (MP) for the recovery interval. 2nd interval: Burpees (modified if necessary). Choose another dynamic stretch from MP for the recovery interval. 3rd interval: Kettlebell swings. Choose another dynamic stretch from MP for the recovery interval.

In order to provide some variety to the cardiovascular training program, also work in MIT sessions as well. MIT training sessions should be done at 65%-80% of Max HR or an RPE of 13-15 and for 20-60 continuous minutes.

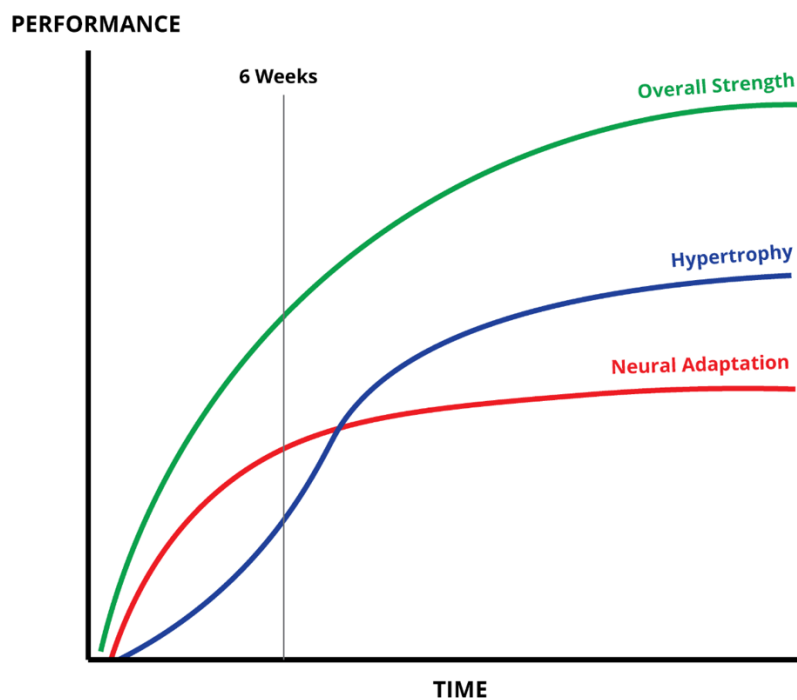
Here are some recommendations to ensure that cardiovascular/metabolic training is performed safely with your active older clients:

- Recommend using safety clips with automatic shut off on cardio machines, especially during HIIT intervals.
- If using new or unfamiliar cardio equipment, provide a thorough orientation to the function of the machine.
- If the client is taking medications that reduce heart rate response during exercise (e.g., beta blockers), instruct the client on the RPE scale and use it to judge exercise intensity.
- Monitor for symptoms of exhaustion and/or cardiovascular issues. Speak to your client on a regular basis to judge whether he/she is laboring.
- Be particularly careful when using media (e.g., TV, smart phones, music) on cardiovascular equipment. It may be distracting and lead to a loss of balance.

Muscle Strength/Endurance/Power Training

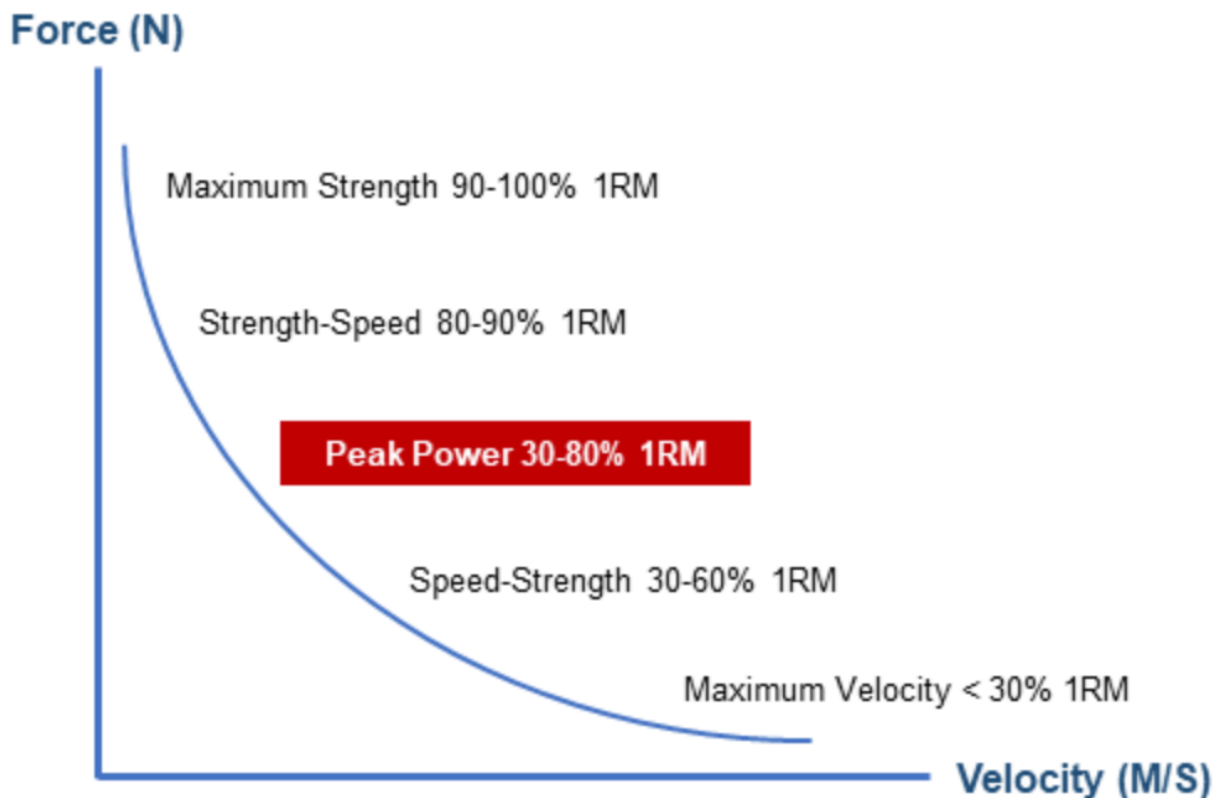
Research has demonstrated that older adults can improve musculoskeletal function at any age (41,42). The two major aspects of muscle performance for the active older adult are muscle strength and muscle power. In fact, there is evidence that maximal strength and explosive power are strongly related to everything from walking speed to fall prevention to cognitive health in older age (43).

In order to improve muscle performance, it is important to remember that gains are made both through improvements in neural recruitment of muscle fibers (typically maximized in the first 8 weeks of training) and increases in muscle mass and muscle quality (typically a long-term adaptation). The rate at which muscle performance improves is generally fastest in the early stages of a training program where neural recruitment is still improving and therefore increasing the number of muscle fibers that are contributing to producing force. As a training program progresses, the rate of improvement will slow down, but is still possible due to slow gains in muscle mass and improvements in muscle quality.



From an exercise program design standpoint, there is a simple approach to guide exercise programming for muscle strength and muscle power. The two primary variables of interest are the ability to generate force (i.e., strength) and the ability to produce force quickly (i.e., power). The

interaction of these variables is seen in the Force-Velocity Curve (F-V Curve) which illustrates that as the amount of force generation (i.e., weight lifted) increases, the speed of contraction will decrease.



The Force-Velocity Curve

To select exercises for muscle strength and muscle power, Dr. Joe Signorile coined the phrase “Surfing the Force/Velocity Curve”, meaning that different exercises to train the different locations on the F-V curve all must be integrated into the overall training program (8,9). The variety of exercises for muscle performance that will be included in their programs will add the variety that they desire in their training programs. Additionally, it provides you the opportunity to use a variety of resistance training

techniques and tools, including body weight training (including suspension training), modular equipment (e.g., dumbbells, kettlebells, medicine balls, elastic tubing...etc.), or selectorized equipment in order to keep the program fresh and to stress the musculoskeletal system in a variety of ways. Additionally, there are certain movement patterns (e.g., squat/hinge, row, split stance, overhead actions & carry/transfers) that are necessary for older adults to be able to perform effectively for active aging and independence. Resistance training should focus on these functional movement patterns. Robert Linkul has advanced training courses on these topics which can be found here: <https://www.trainingtheolderadult.com>

To increase maximal muscle strength, include exercises that are associated with the left side of the F-V Curve where high amounts of force are required (75%+ of 1-RM). This is the concept of “high weight, low repetition” and includes muscle group-specific training such as leg press, squats, pull-ups, rows, chest press, shoulder press and the like. Additionally, loaded movements with speed, such as Olympic lifting can be an excellent solution for building muscle strength. Classic research studies have proven that heavy resistance training can increase both maximal strength and muscle mass (41,42). A focus on both concentric and eccentric strength training is recommended because older adults need to both produce force (concentric) and also control the effects of gravitational force (eccentric) which leads to optimal movement control in your active older adults. And, although single set resistance training has shown to improve strength in low functioning older adults, your active older adults should perform 2-4 sets per exercise.



Muscle power training is best done closer to the right side of the F-V Curve where a lighter mass is lifted (30-50% 1-RM or ~10% of body weight) at a rapid speed which elicits a greater adaptive response to power variables than using heavy loads (80% 1-RM) (43). Exercises such as medicine ball throws, kettlebell swings, and battling ropes are excellent choices for muscle power training. Muscle power training has been shown to increase rate of force development which has a significant effect on improving functional performance such as speed, sport-specific performance, and fall risk reduction (44,45,46). Recent research has also indicated that there faster and more sizeable improvements in muscle power with multiple short sets (8-12 sets of 5-10 seconds each) and short recovery periods and when there is minimal power loss from repetition-to-repetition and from set-to-set during the workout. Based on this, the active ager should be coached to keep a little “gas in the tank” during the performance of each set and try to maintain performance throughout the workout (47). Further guidance on this topic can be found on the Functional Aging Institute’s website where

Paul Holbrook has a course specifically on this topic:

<https://fai.securechkout.com/rapid-movement-training>

Fitness Domain	Time/Sets/Reps Intensity Recovery Time
Muscle Strength	2-4 sets of 6-10 repetitions 75%+ of 1-RM 2-minute recovery
Muscle Power	6-12 sets of 5-20 seconds (total and/or each side) 30-50% of 1-RM or ~10% Body Weight 20-30 second recovery

Here are some recommendations to ensure that resistance training is performed safely with your active older clients:

- If performing Olympic lifts, demonstrate proper form so that injury risk is minimized. Make sure that feedback and instructions include verbal, visual and, with permission, tactile cues.
- If using selectorized equipment, do not start any movement at joint angles that are beyond normal range of motion. Muscle and connective tissue injuries may occur if a loaded muscle is taken beyond its available range of motion.
- Always encourage deliberate breathing during lifts in order to ensure proper trunk stabilization and avoid rapid increases in blood pressure.
- For both heavy weight training and Olympic lifts, perform an initial set of each exercise with little to no weight so that motor unit recruitment can be stimulated and subsequent loaded sets can be performed with proper form.

- Remind your active ager that resistance training is likely to induce delayed onset muscle soreness (DOMS) and that DOMS may take longer to dissipate in older adults (perhaps up to 4 days).

Flexibility Training

There are a variety of flexibility techniques that can be used with your active older clients. These include static stretching, dynamic stretching, ballistic stretching, PNF stretching and specialized approaches such as Active Release Techniques and Muscle Activation Techniques. Selection of these flexibility techniques should be dependent on the specific objectives of the training session and where your active ager is in their periodized training cycle. Intense training sessions should integrate more dynamic stretching during rest periods to reduce tightening up. Recovery training sessions can be more geared toward corrective exercise where specialized flexibility techniques may be the focus of the session. Specific instruction on these flexibility techniques are beyond the scope of this course and some (e.g., ART and MAT) require completion of specific training courses, but there here are some important considerations when training flexibility with your active older clients:

- Always include at least 5 minutes of cardio warm-up prior to flexibility work in order to increase muscle tissue temperature and blood flow. Stretching muscles that are not properly warmed up will put your older client at a higher risk of injury during the session.
- When performing static stretching with older clients, discourage bouncing at the end range of motion. This will cause the stretch

reflex to counteract the purpose of the stretch and may also lead to a soft tissue injury.

- Encourage deliberate breathing during any flexibility exercise and watch for breath holding at end range of stretches.
- Stop immediately if an exercise causes discomfort or pain in a joint.
- Your active aging clients may enjoy the added challenge of sensory challenges during their flexibility work – consider using an unstable surface or have your client close their eyes or shake their head to challenge them. To be safe, always have something available for balance assistance (e.g., standing foam roller, chair).

Core Training

Research has demonstrated that core musculature is activated prior to the muscle groups in the extremities in order to stabilize and protect the torso and to produce forceful movements (48). This is important in activities like sports, lifting and carrying, and recovery of balance from trips and stumbles. Older adults, even active agers, typically do not have adequate core stability and are at increased risk for both axial (e.g., postural issues, low back pain) and appendicular (e.g., knee pain, hip pain) problems. This underscores the importance of core exercise as an essential component of a training program for active older adults and will assist in the prevention and management of chronic pain issues. Exercises such as planks, bridges and anti-rotation exercises are excellent choices for core training



Here are some recommendations to ensure that core training is performed safely with your active older clients:

- Watch for dizziness due to hypotension if the client gets up too quickly. Encourage slow changes of body position.
- Muscle cramps in the hamstrings and/or quadriceps are common when performing core exercises for the torso. A lack of neural drive to the core muscles will lead to synergistic muscles to do too much work and cramp up. Start with very small amplitude movements and short durations of repetitions to reduce this issue.
- Always encourage deliberate breathing during core exercises. Isometric contractions often lead to holding of breath causing increases in blood pressure.
- Watch for excessive flexion and/or extension of all regions of the spine with core exercises. Limited movement in one spinal segment may lead to unwanted movement at another segment.

Sensory and Balance/Agility Training

Balance refers to the ability for the body to maintain postural control while changing position and/or direction (dynamic balance/agility) or while not moving (static balance). Hiking a mountain trail, stepping into and out of a kayak, playing sports, social dancing, and holding the tree pose in yoga class – these all require an expression of balance. Additionally, the balance-related sensory systems (i.e., visual, vestibular and somatosensory systems) are involved with successful maintenance of balance in daily life. Fortunately, these systems have been shown to be responsive to exercise training and can enable an active ager to be successful at living an active and independent life (49).

The integration of vision, vestibular, and somatosensory inputs are essential in the maintenance of balance. It is suggested that sensory challenges are regularly built into the training programs for your active older clients. Training the vestibular system by head motions (i.e., rotating or nodding the head) has been shown to improve the integration of the body's balance control mechanisms (51). Additionally, visual tracking (i.e., shifting eyes) or closed eye training has shown to be valuable in a similar fashion (19). And, using modified stances and/or unstable surfaces can improve sensory information coming into the central nervous system by recruiting more joint mechanoreceptors and soft tissue receptors. This improves the function of the somatosensory system and results in better resultant movement strategies that maintain balance (24).



Research has recently indicated that balance can be improved and risk for falls can be reduced in as little as one training session (50). However, the evidence points to a commitment to balance and agility training to see long-term improvements in postural control which can allow your active older clients to fully engage in their vibrant lives (43). Although no specific exercise recommendations have been developed for the frequency or duration of sensory and balance/agility training, it has been recommended to train this domain often and to make the chosen exercises more challenging than what the older adult would normally experience (44). Note that the duration of balance and agility training sets recommended allow them to be delivered during recovery periods of the strength, power and metabolic training sets within a workout session. This creates a situation where sensory, balance and agility training is trained when the active ager is in a relatively fatigued state – which helps to prepare the individual for balance challenges in the real world when the body is tired (e.g., the last

ski run of the day, the final game of a tennis match...etc.). A list of exercise options for each category is listed below:

- Sensory Enhancement: Eye tracking (e.g., tossing a ball) while standing or moving, head turning (e.g., simulating checking traffic while crossing a street) while standing or moving
- Statis Balance: Staggered/tandem stance upper body reaches/rotations, Single leg multiplanar foot reaches
- Dynamic Balance/Agility: Multiplanar hop-to-balance, Reactive ball catches to balance

In terms of intensity or difficulty, strive for with your active older clients is what is called the “75% Rule” to gauge exercise challenge. This means you should strive to identify a level of difficulty for an exercise where the client can maintain postural control for 75% of its duration. That means the other 25% of the time, the client is wobbling, losing balance, needing to reset position...etc. This is the sweet spot of training where the entire body and mind are engaged in the process of performing the exercise correctly. The adaptation response is most effective when the exercise is challenging to this degree (46).

The 75% Rule can be found by progressing or regressing your balance and agility training strategies through variations such as width of base of support (e.g., narrow or single legged stance), type of surface (e.g., flat floor, Airex pad), sensory challenges (e.g., open or closed eyes), direction of movement (e.g., forward stepping, rotational stepping), or other options (using a TRX for support, use unilateral loading for

postural challenge). Further guidance on this topic can be found on the Functional Aging Institute's website where Dr. Chris Thompson has a course specifically on this topic: <https://fai.securechkout.com/complete-guide-balance-training>

Fitness Domain	Time or Sets & Reps
Sensory Stimulation	2 sets of 20-60 seconds (total and/or each side)
Static Balance	2 sets of 20-60 seconds (total and/or each side)
Dynamic Balance/Agility	2 sets of 20-60 seconds (total and/or each side)

Here are some recommendations to ensure that sensory/balance/agility training is performed safely with your active older clients:

- Always have external support available for balance assistance (e.g., standing foam roller, chair) when performing these exercises. It can help provide reassurance to your older client and reduce anxiety.
- Begin balance and agility training exercises in the sagittal plane, followed by the frontal plane, and finally the transverse plane.
- During sagittal plane exercises, pay special attention with backward stepping due to its unfamiliar motion.
- Proceed with caution when performing dynamic balance or agility exercises that require vertical displacement (e.g., hops, box jumps) due to the possibility of exacerbating arthritic conditions or other musculoskeletal impairments.

Integrating Dual Task Challenges

Our active aging clients have a desire for enjoyable and engaging exercise programming. A great way to do this is by integrating what is known as dual tasking into training sessions. A dual task is defined as performing two activities simultaneously. Exercise itself is considered a physical task and it can be paired with additional physical tasks (e.g., tossing a ball, clapping...etc.), sensory tasks (e.g., shifting eyes, turning head...etc.) or cognitive tasks (e.g., mathematic challenges, verbal challenges...etc.).

As described earlier, there is ample evidence to suggest that cognitive function can be improved by participation in exercise training and it is typical that the active ager is a mentally sharp individual (27,28). However, that does not mean that the cognitive element of training should be completely overlooked in this population. Integration of cognitive elements such as attention, memory, and problem solving into a training session is an excellent way to add cognitive dual tasking to an active ager's training program and derive significant benefit to both executive function and memory abilities (28).

Here are some recommendations to integrate cognitive challenges into various exercises:

- Give mathematical challenges such as addition, subtraction, multiplication and division to cue different movement planes during an exercise (e.g., for muscle power: sagittal plane hops with an even

number solution, frontal plane hops with an odd number solution, transverse plane hops with a negative or zero number solution).

- Cue verbal recall during an exercise (e.g., for dynamic balance: step to balance while naming all animals that begin with the letter “G” and continue until 60 seconds has elapsed).
- Challenge working memory during and exercise (e.g., for muscle strength: give a sequence of words prior to a set of deadlifts and have the client recall the sequence after completion of the set).

There is an excellent online training program through the Functional Aging Institute, the Brain Health Trainer by Ryan Glatt for further information and ideas. It can be found at www.brainhealthtrainer.com