

# Motor Learning and Control Fundamentals

by Heather Dibkey

## Definitions

- **Motor Skills** - actions that require voluntary head, body and/or limb movement to achieve a specific outcome
- **Motor Control** - how the neuromuscular system functions to initiate and coordinate the muscles and limbs in order to achieve the desired motor skill
- **Motor Learning** - involves the acquisition of those motor skills, the enhancement of a motor skill or the reacquisition of a skill

## Stages of Learning

When people practice a new skill and continue to practice that skill, they progress through distinct stages of learning. The Fitts and Posner model proposes that there are three stages of learning:

1. **Cognitive** – problem solving and direct attention to the movements being performed
2. **Associative** – cognitive activity is decreased and the learner works to refine the skill to increase performance success and consistency
3. **Autonomous** – the learner performs skillfully, almost automatically, with little conscious attention directed to the movements

In the third stage, the person is capable of adapting the movement pattern to any situation. He/she performs the movement with more efficiency, stability and coordination with less effort or energy required. As a result, fewer muscles are activated and the timing of the muscle activation improves as the limbs work together as a functional unit. The more consistent one is with practicing these motor skills, the quicker he/she will progress to an autonomous state. In fact, truly becoming an expert at a motor skill takes at least ten years of consistent and intentional practice. So, what does that mean for Pilates teachers and how can we assist our clients in reaching an autonomous stage of learning where the client moves skillfully not only during Pilates but in everything they do? The remainder of this article will highlight some fundamental application techniques to consider.

## Transfer of Learning

When working with new clients, our goal is to help them achieve the motor skill or movement being requested. The result might not be pretty; however, trial and error is a part of the learning process and should be encouraged to help clients maximize their capability to perform the skill in a variety of contexts and situations. In addition, our instruction should also encourage movement characteristics that will enable them to experience some degree of success. We *do* want them to come back! Therefore, we should instruct clients in the beginning to mimic movements that are both familiar to them and that mirror the new skill being asked of them. This is called transfer of learning. The use of mental imagery or word pictures is an excellent tool in helping the client with transfer of learning. Having the client perform similar movements in a variety of situations with the same cueing will help the client develop consistency.

The sequencing of skills should always be simple-to-complex as each skill benefits from previous skills acquired. Therefore, it is important to always start with bilateral limb movements where both limbs are moving in unison as the motor control system initially learns in a non-limb specific way. Once competency is achieved, single limb movements can be incorporated. It is important to start with the preferred limb to capitalize on bilateral transfer. Bilateral transfer increases improvement in the performance of the non-preferred limb from practicing first with the preferred limb. Then, limb movements should be alternated once the movement is achieved.

## Demonstration/Sensory Feedback

Demonstration is most effective when the skill is a new one and the client is in the beginning stage of learning. While demonstrating, repeat the skill several times for the client and point out the most important aspect of the skill using simple and focused verbal cues that instruct the client on what *to* do. Avoid telling the client what *not* to do, especially if short-term memory is an issue. Similarly, avoid providing a running monologue or commentary, which can prove overwhelming.

Another demonstration technique that can be very effective in the beginning stages of learning is having new clients observe another beginner. Not only will the observing beginner see the movement errors but also how the person practicing the skill is working to correct those errors. From my experience, it encourages the new clients to see that they are not abnormal and that none of us start out as fine Pilates specimens. The reason demonstration is so effective is that it utilizes vision, the most relied upon and trusted sense. Unfortunately, a new client will often rely too much on vision for feedback. An equally effective technique is to use tactile or touch feedback to provide additional sensory feedback to the client. Mechanoreceptors on the skin are the sensory receptors that provide information on activation of the muscles and movement of the bones and joints. It helps with movement accuracy and movement consistency. Many clients are challenged by body awareness in the beginning, and tactile feedback is an important part of helping them progress to the autonomous stage of learning. It helps the clients become confident, learning to trust what their body is telling them and not just on what they see or what we as teachers are telling them.

**Examples of Bilateral limb movement** include any exercise where the legs and arms are moving in unison. Double Leg Toe Taps with the straps at the knees (*as shown below*) or the supine mid-back series (*Ribcage and Angel Arms*) with the straps in the hands are specific examples. After success with bilateral limb movement, single limb movement should be introduced to develop more symmetry between the sides of the body. Start by taking the above examples and breaking them down into single arm or leg movements beginning with the more dominant limb first to capitalize on bilateral transfer (*as shown below*). While performing the more dominant limb movement, I specifically instruct a client to try to internalize how the movement feels by highlighting the muscles responsible for both movement and stabilization. When we switch to the less dominant limb, I urge them to try to recreate the same feel as far as muscle engagement and ease of movement that was experienced while working the dominant side. Bilateral transfer is also very educational as to imbalances between the sides of the body and assists with sensory feedback. Examples of whole practice are Snake and Semi-Circle on the Reformer; both highly coordinated and complex movements. An example of partial practice would be the Rowing exercises or Coordination. These can easily be broken down into separate parts and later put together to create one fluid movement.

### Demonstrator is Amber Clark



**Keeping the arms still at the side of the body to engage the abdominal wrap muscles while the legs are moving in and out of knee fold (toe taps). Classic bilateral limb movement.**



**Now, moving into single limb movement starting with the more dominant leg first.**

*The above pictures also highlight 'part practice.'*

## Augmented Feedback

A large part of what we do as Pilates teachers is to provide feedback. Augmented feedback is performance-related feedback and has two primary functions. First, the feedback facilitates achievement of the skill. Second, it motivates the client to strive toward achievement of the skill. In the beginning, try not to give feedback that is too specific, as beginners need general information that will help them make a “ballpark” approximation of what is needed to execute the movement. Try to incorporate positive feedback with error-correction feedback. Prioritize the error-correction feedback to one most important element to avoid overloading the client. Occasionally ask the client to tell you what movement errors they have made and how they would correct them before giving your feedback. This will encourage clients to develop their own sensory feedback while performing the movement or motor skill. For example, I asked one client to go for a little walk in the snow. After several steps, I instructed her to stop, turn around and observe her tracks. I asked her to tell me what she saw. Finally, she understood what I had been telling her. She realized that she walks with a large amount of external rotation and that, indeed, she externally rotates her right leg much more than her left. The feedback she received confirmed why we were doing certain exercises, motivated her to keep coming and, more importantly, gave her confidence to begin to trust her own sensory feedback. As the clients reach the autonomous stage of learning, they will become more capable of detecting and correcting their own errors.

## Practice Conditions

Don't hesitate to recommend shorter more frequent sessions. Although this might not always be feasible for the client, the consistency from more frequent participation is truly instrumental in learning a new skill and in progressing through the stages of learning. Likewise, smaller more frequent sessions can be an excellent tool for those clients with attention related deficits. Let's face it; most people aren't conditioned to thinking so much during exercise, and some clients are more challenged than others. Those frequent shorter sessions give the client one thing to think about and practice until the next session.

Another component to consider is called whole and part practice. Do you introduce an exercise as a whole movement or do you break the move down into smaller parts? After the PMI's Fundamentals are introduced and you get into the Pilates exercises, employing whole and part practice can be very beneficial to progress clients efficiently through the stages of learning. Which method you use depends upon the complexity and the organizational demands of the motor skill. Complexity means there are many parts to the skill and the information processing demands are high. Organization refers to how interconnected the parts are. Skills that are high in organization rely upon the previous parts for execution. Whole practice strategies should be used when a skill is low in complexity and high in organization. Part practice should be used when the skill is higher in complexity and low in organization. Essentially, interdependent skills should be practiced together (*whole practice*), whereas parts that are independent should be practiced separately (*part practice*). Employing motor learning and control techniques can greatly benefit your clients and assist you with being a more effective teacher.

## References:

Magill, R.A. (2007). Motor Learning and Control Concepts and Applications, 8<sup>th</sup> edition

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