GOLFSCIENCELAB.COM

Quickstart Guide to Motor Learning for Golf

An introductory look at how you should be practicing and learning golf

Motor Learning = The process of improving motor skills through practice, with long-lasting changes in the capability for responding.

Motor Learning and how to practice more effectively in golf - is one of the places with the greatest gains in golf. It's a topic we don't talk about enough but can have a MASSIVE difference in the rate of improvement (or lack of).

Reality is most of us waste time practicing. And maybe deep down you know it but don't change it. The common "best practices" aren't based on research in learning and skill acquisition. That's why we're changing the conversation and talking with the academics about what's been happening.

In this guide we're going to cover some of the primary topics, give you new mental frameworks, and tips about how you can change your learning and practice.

Research tends to suggest that golf is a problem solving process. The problem is how to get the ball from point A to point B and the solution is the type of swing that you will implement. With the reality that there are a countless different ways to get from point A to point B.

One argument is that we can't repeat a swing exactly from one time to the next so why bother trying? Rather than putting the emphasis on okay here is the problem, here is where we want to get to, how am I going to execute that?

The way to practice that is to create a problem on each and every practice attempt. Each and every shot should be a simulation of something one may have to deal with in a real-time playing environment. To do this re-creating a situation, simulating an intensity and regulating the whole process will provide an opportunity for golfers to chunk. Chunks are the accessible knowledge of a past experience, which for golfers might be that seven iron, downhill, into the wind and the pin tucked back left. So when you put another ball down, create a new problem (keeping in mind the three bold points above) and then figure out how you're going to get there from point A to point B. It might be the same club but you might say okay I've got seven iron I am hitting it downwind now let's imagine when I am hitting it into the wind, how am I going to execute that or solve that problem differently?

You might come up with a completely different way of hitting that shot even though it's the same club.

Performance vs. Learning

The distinction between learning and performance is fundamental - going back decades in research both with animals and humans.

Performance is what you can observe and measure during the time people are trying to learn or execute on a skill they've been taught.

Learning has to be inferred and will only become apparent at a later time. Can you then perform when it matters, can you transfer from the practice environment to a performance environment, and can you apply this learning to any new situation?

It's very easy for people to think that their current performance during the training and learning process is an accurate index of learning.

Often it's not only NOT accurate, it's very, very misleading.

That's because conditions that can lead to rapid improvement in performance does not support long-term learning. In contrast, other conditions that appeared to create challenges for the learners appeared to be slowing down their learning process.

These desirable difficulties in the practice and learning environment can actually enhance long-term learning. So it's a major factor. It's one basic reason why people do not practice in an optimal situation and why instructors often don't choose optimal conditions of instruction.

When most think of practice it's simply something to see how well they are hitting the ball right there and then, how does it feel, and where is it going.

If somebody gets into doing what we call block practice; they hit one ball, rake a ball over and hit another one, standing there always sort of parallel to the lines or on the map, and admire the ball against the sky never actually aiming it at anything specific.

People think that will lead to good immediate performance because if you hit a good shot, you'll drag a ball over and do what you just did.

Very little learning happens with that kind of blocked mass practice.

During a round of golf, you won't have that opportunity to repeat the same shot as in block practice. Now you have to go to the next shot and hit a different club from a different line and maybe even a different target.

Because of the over emphasis in our culture on talent and innate abilities the experience of practice seems to become undervalued and the difficulties surrounding practice are seen in a negative light.

Often people will predict their future learning based on their performance at the time of their practice.

For instance if someone recently performed really well in a practice session, they predict that their performance on the course will match that of the range… However in most cases that's not what will happen.

That's a problem because if you walk onto the golf course with expectations that are very high and suddenly you perform average or below average, then the disparity between your expectation and reality can create a big knock in your confidence and can set off a cycle of self-doubt. To get a realization of how poor a players practice can be and how it can add to the already huge disparity, play a round of golf, preferrably on a quiet day and score your 4th or 5th ball on every shot as well as your first. Notice the difference between scores and realize that if the game was played like that i.e. 4 or 5 balls from exactly the same place, then that's what you could score. But low and behold it is not, you get one chance so if you aren't practicing like the game, then you will never get that much better at the game.

That's where a high performance on the range can really have a negative effect on the golf course.

The reverse is also true. If you get someone practicing at the proper level of difficulty then their performance will usually be lower, than the expectations of a player.

Although they may feel a little deflated, when they go on to the golf course and start performing average, their mindset is a little different because they are performing better than their expectations

and they go, "Oh, that's a little better" and which allows the confidence to raise. Alongside the improved confidence and self esteem that can be created through the use of better practice, what can be evident is greater emotional control. If we can create a strong enough emotional attachment to practicing more - better it will stick and we can raise the average of golfing performance.

We all know it's about time the average handicap dropped!

So how you perform on the range and how do you perform on the course, you need to balance all of these things: your expectations levels, your confidence levels and the performance levels.

And the good news!?

By improving your practice and practicing more game-like, you'll indirectly improve your ability to balance the above.

RANDOM VS BLOCK PRACTICE

Research on random and block practice started in 1979, by Shea and Morgan they did a study in which they compared two groups; each group of individuals practiced three different variations of a motor skill. They had 18 practice trials of each task. In block practice they would practice task A for 18 trials in a row, task B for 18 trials in a row and task C for 18 trials in a row.

It was a very drill type of practice with minimal amount of interference from task to task.

That was opposite to the second group which they called the random group in which there was no more than two trials of any one task in a row.

So for example it would look like: Task A – Task B – Task A – Task C, maybe another task C again and back to A and then to B. Although they completed the same amount of trials as in the first test this was completely random (also referred to as interleave) with the notion that there is no minimal amount of repetition of the same task.

So what happened?
Block practice users had better performance during the initial trial.

If you can do something 18 trials in a row, you get better doing that task much quicker than you would with random practice.

If your goal is to make a quick adjustment to the tasks then block practice is probably the advantage.

The more overriding concern, what Shea and Morgan are well-known for is that they asked people to come back for retention tests in which they said, "Come back to the lab a couple days later and we'll see how well you do in these tasks, how well you remembered to perform these tasks." What happened is that the block group did very well during the initial assessment, yet when they returned they did very, very poorly. In fact, they performed as if they had never practiced the task before.

On the other hand the random group did not perform well during the initial stage, but seemed to retain what they had learned very well.

So the point was that block practice is good if you want to show someone temporary effects but if you want long-terms benefits and transferred ability you are better off with random practice.

An analogy would be: you are studying for an exam, this research has been done as well, if you want to retain information long enough to be relatively successful on a test and an examination the cramming is not a bad strategy.

If you have a goal of retaining that information for any length of time, then what's called spacing practice or doing short study intervals over a long period of time is probably a much more effective technique.

How does this transfer to learning and practicing golf?

The answer depends on a number of factors, who is the individual, what the skill level of the individual is, and other factors.

For a beginner, you might want to introduce more block practice into the practice sessions than you would with a highly skilled player. One very practical reason being they'll see success sooner – encouraging them to continue with the game and not give up.

Another way would be to create a game so that players would see instant success with i.e. setting up putts from inside 3 feet, have the green staff make a hole 5 times bigger than the original size for games, make putting game pars 4 instead of 2. These are just basic examples, there are a million different games that beginners can play and perceive instant success with. Within these real time games coaches can make beginner type adjustments. What is key to cultivate, especially to a newbie is that it is just a game and so we start out with easy, rewarding, fun games, develop skills and up the ante as we go along.

A highly skilled player would want to try and use random practice throughout the entire practice session, for better retention and long lasting impact of the practice and learning.

As Dr Tim Lee says: "You can mix block and random practice in a month or so depending upon what it is you want to achieve and how you want to achieve it depending on your skill level."

HOW THE PRACTICE ENVIRONMENT SHOULD BE SET UP

The problem with most ranges (the average golfers practice and learning environment) is the difficulty level… It's simply not challenging the golfer in the correct way.

When most go to the range they spend a majority of the time on a flat piece of ground setting up perfect lies with their favorite club not setting up desirable difficulties. Which are crucial to making practice effective. People may not like it so much because people like to do the things they are already good at.

An ideal practice environment physically should have the kind of things that you'd find on a golf course like sidehill lies, a rough, bunkers, obstacles to hit around and anything else you might encounter when on the course. The goal being to give yourself problems to come up with and practice solutions to those problems.

If possible the best practice and learning environment is the course itself. Attempting to hit all of the shots that would come up on a normal round, some examples being a left to right shot, a low punch shot under a tree, a downhill shot over a bunk drop another one.

This kind of practice on an actual course, where you set up challenges for yourself, and when you are having a problem with a certain kind of shot – don't try to avoid that shot but include those in your practice round.

The golf practice world does not help the sport grow. Driving ranges unfortunately are not where golfers play on. However, anybody can make the best of a bad situation. A good friend of mine gives some great points in his Game Like Training Manual, and it can be summed up as this: Look for what you can incorporate on the range that you experience on the course. Time between shots – make yourself walk somewhere after each ball, choose a different club on every golf ball - get all of your golf clubs out and force yourself to never stick to the same one, even if you hit it "bad".

Here's an example of the issues with a "perfect" practice environment from Peter Arnott:

Two years ago, I had a Nigerian client come across, he was studying to be a doctor in a local university. He had golf lessons on a driving range in Nigeria, a complete beginner. He came to our indoor trackman hitting area and hit shots for about 15 to 20 minutes, never missing the ball once.

Then I wanted to put him into a realistic learning environment. I took him out to the course and set him on the downhill line, what do you think happened?

He missed the ball seven times in a row. He had never been in an environment like that so he didn't know how to hit that type of shot.

DESIRABLE DIFFICULTIES
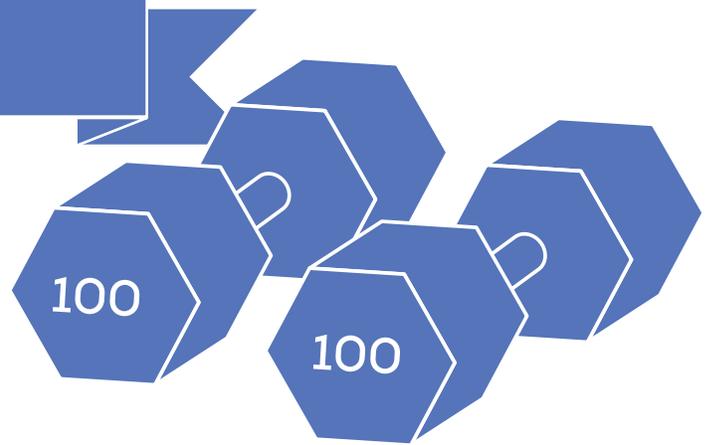
Desirable difficulties are one of the key pieces to effective practice and learning. In fact it's the one piece that brings all the different techniques together. For example, if you are using random, interleaved, and varied practice effectively yet have the difficulty level wrong you're not going to be getting optimal results.

It's easy to understand desirable difficulties when relating it to physical activity and exercise. If you're lifting weights you'd understand if the weight was to light and was extremely easy you wouldn't be getting stronger. This same concept applies to learning.

This example from Dr. Mark Guadagnoli really makes it clear:

If you do ten reps of a bench-press, it's really only the last three or four reps where you are struggling and growing, and it's the exact same thing in any kind of learning.

In this bench-press example, if you struggle on the very first one, that's too much challenge. That's not a desirable difficulty, that's a beyond desirable difficulty. And so we have the sort of goldilocks complex where there is a sweet spot right in the middle; not too much not too little, and really part of the art of teaching I think is finding that sweet spot.

It's hard to consistently use desirable difficulties effectively when practicing as they create lowered performance, but increase long term learning. Some players will get very demoralized by having a task set that's too difficult for them and that can actually hinder learning in itself in that the confidence gets so low the player gives up, their mindset flips over. The reverse is true also; if a task is too easy, that is not a challenge to a player, the learning is completely dropped.

Golf Coach Adam Young suggests this about setting appropriate difficulties:

If someone is achieving a seven out of ten success rate in the task that I have set them, I will consider it too easy and I will increase the difficulty incrementally by adding another constraint to it, or adding some level of difficulty.

And the reverse is true if someone is only getting three out of ten; I would normally lower the difficulty level of that task so that it encourages confidence and a feeling that the player is learning.

As you learn and grow your level of desirable difficulties needs to change appropriately. When that happens you'll see your learning and improvement being to flat line and become stagnant. If you ever get "comfortable" you know you're probably not where you need to be.

VARIABLE AND INTERLEAVED

Two techniques in practice that are vital to understand in the context of random and block practice are variable and interleaved.
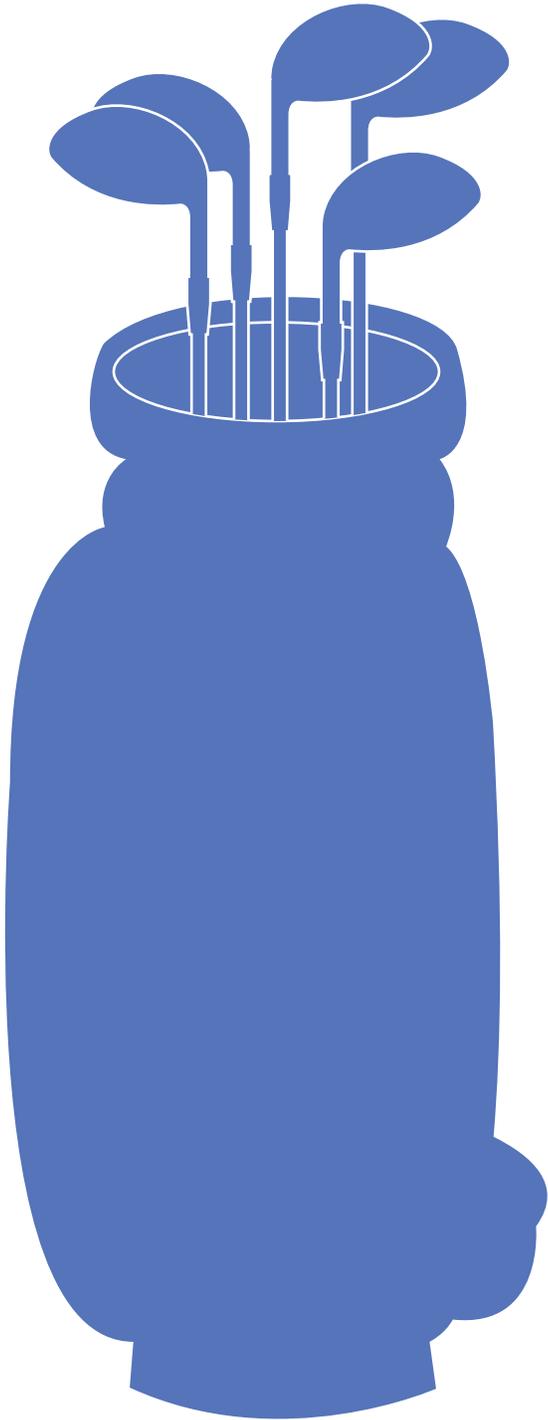
Variable:

Variable practice is finding different solutions to a problem.

You have the goal to hit the green with your 7 iron but you're going to hit one right left extremely high and then one left right that's low. You have the same lie, stance, club, and target but you're using a different "solution" to solve the problem.

It might be nothing that you settle on eventually when you go to achieve maximum performance but it helps you in learning coordination and lot of other things also.

Interleaved:

In the context of golf this interleaved practice could simply look like switching between different clubs for each shot. Changing the target or lie to give you a different problem to solve each shot or task undertaken.

Matthew Cooke creates stations to really take advantage of the interleaved practice framework. Once again he tries to make the practice as close

to the game itself, which is interleaved. Driver, iron shot, chip and putt, typically. So Matthew has a station on the range, a station on the putting green, and a station around the chipping area, a station in the practice bunker etc and has his students working their way through each station. 1 shot at a time recording the perceived outcome of the shot - improvement area, good, excellent are the words that describe the outcomes.

One of the most reliable effects called the spacing effect that said if you are going to study something twice or practice something twice, you have two options, doing them in a row, or you could do one session, go on to do other things and then come back and then do another session.

Long-term learning is much better when you space those practice or study sessions out.

Dr Robert Bjork sheds some more light on this topic:

You go somewhere to learn tennis and, they will work with you on your forehand and then your back hand and on the serve, it will virtually always be working on one thing at a time.

But what research says is you ought to interleave the practice of those things. You won't look like you are making as much progress but you will be learning better.

ECOLOGICAL DYNAMIC MODEL
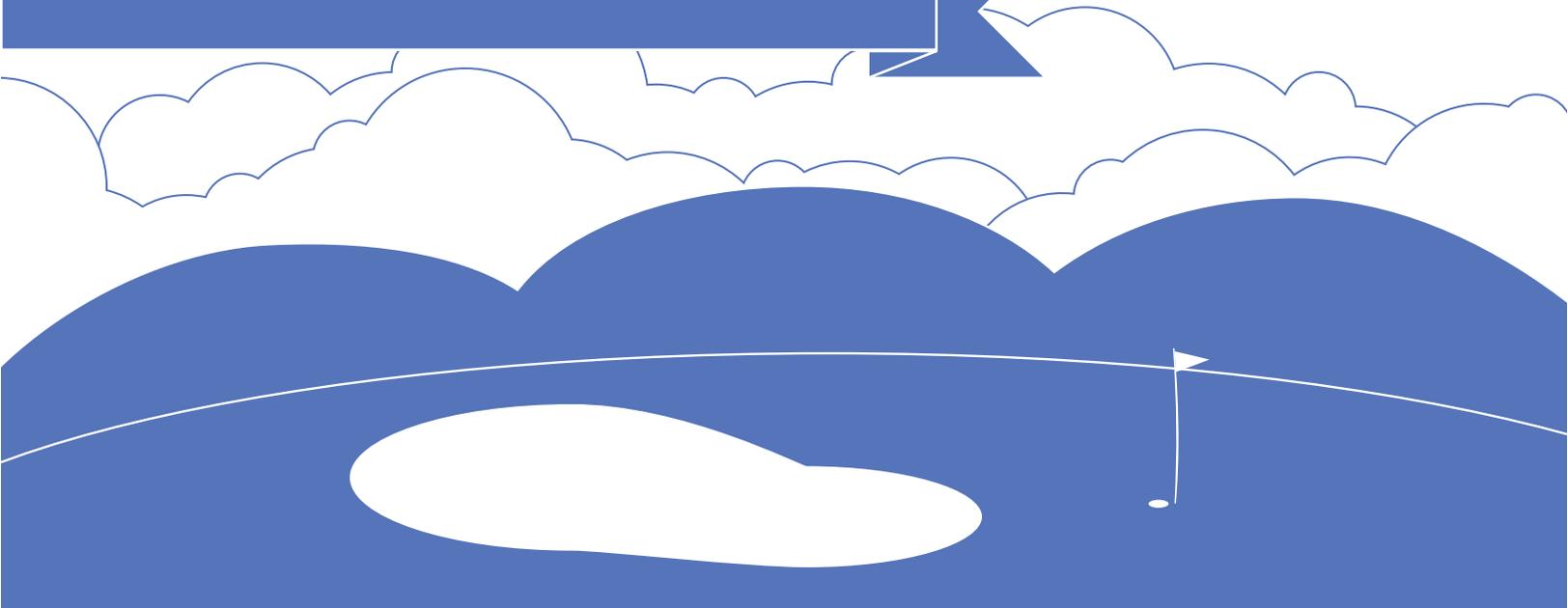
Ecological psychology is really the study of how organisms act in their environment, how they adapt and how they become functional in those environments.

One of the key concepts of that is we are able to directly perceive our environment and we are able to scale movement solution to it.

So it reverses the paradigm.
It says that first of all you've got to find out what the problem is and come up with a solution. The old approach was start off with programming the organism for the solutions, send out a problem. With the ecological dynamics approach you don't give the organism any solutions just appropriate problems and let the organism come up with a solution.
We all act with creativity and novelty and you see these guys in the PGA Tour with different

movement patterns but they are effectively doing the same thing. That is behaving functionally in the environment they are in so they have to come up with a unique solution to a problem. That is the problem – how do you control the golf ball in the golf course at a very, very high level.
Ecological psychology is the study of that, how organisms act in the environment and how organisms adapt to the demands of the environment.
That's where dynamical systems theory comes in (when the two parts are brought together you have ecological dynamics).

Dynamical systems theory is the study of how systems change as a function of time, how they change and why they change.

The human system is very smart.

We just need to provide it with an appropriate environment, an appropriate level of development and you'll see a high level of self-organization.

If we don't self-organize to the demands of the environment then we won't inhabit that environment for very much longer because we are not be able to behave functionally.

So coaches need to make sure that with an ecological dynamics framework, that you are providing the right environment, the right context. Context is a very key concept in all of this because you are going to need to adapt to the environment but you want to make sure that you adapt to an environment that is representative of the environment that you are trying to perform then.

Here's an example from Graeme McDowall

One of my favorite examples is from the PGA tour players when you ask them how they got good at the game and they always start off by saying I was lucky.

I was lucky because I lived very close to a golf course and I was able to play golf every day. I was lucky because my granddad played golf, he was an example and he gave me some clubs that we cut down and I played golf every day and as I got better, I was able to play with better players.

Then I progressively got better and better and I was able to play at a better golf course in the area that was a championship course and there were better players to compete against there.

So we have these emerging examples of people growing the skill level relative to their environments.

So what's in the environment there that I just described? Well there is access to good players and progressively better players, so they got better, the level of competition got better and the difficulty of the golf course got harder.

So they grew their skill into environments and stimulating that growth was harder competition and harder golf course, but luck and also opportunity to do that.

CONSTRAINT BASED COACHING OR ENVIRONMENT
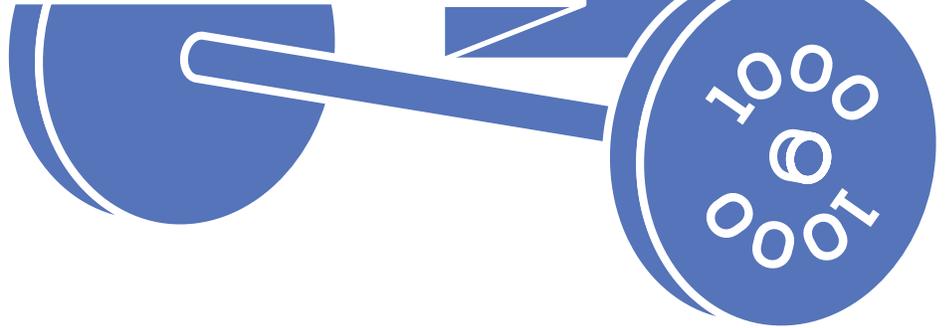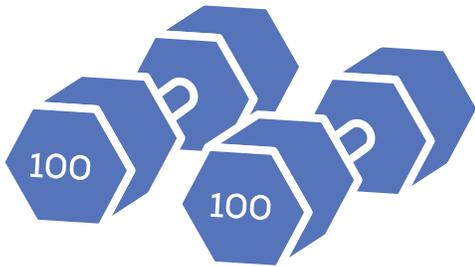
A constraint led approach to coaching is to create problems and then challenging the learner to come up with solutions to those problems.

The learner is then forced to come up with a unique solution to a problem that they struggle with. The solutions could then help to change a motor pattern or any other aspect that was holding the learner back from a solution. From a scientific standpoint you're moving an organism away from its equilibrium to what we call a bifurcation point where you force the action system to branch out to try something or bring order back into the situation. That means learning new motor patterns, new strategies, new thought patterns.

The goal with constraint based coaching is to train players beyond the needs of performance.

If your training level is high, or above the needs of performance, when you actually need to perform in competition it becomes easier.
What most golfers do is train below the needs of performance and when they actually try and

perform, they find it difficult.

Golf Coach Peter Arnott shares a great example:

Basically I call this constraint based game "How low can you go". It's six hours on the golf course until the task is completed. I had a player that was really technically focused and had forgotten how to score. I simply wanted him to figure out how to score again. So I sent him to do a task of getting 10 under par playing from the junior or ladies tees and he was out there for six hours until he accomplished that task.

It's setting the problem for the athletes to solve including questions and encouraging learners to take more responsibility for their learning. Each individual's solution to a problem is different. Constraint based coaching is all about letting the individual find a way that is fit for them to solve the problem instead of putting them in positions.
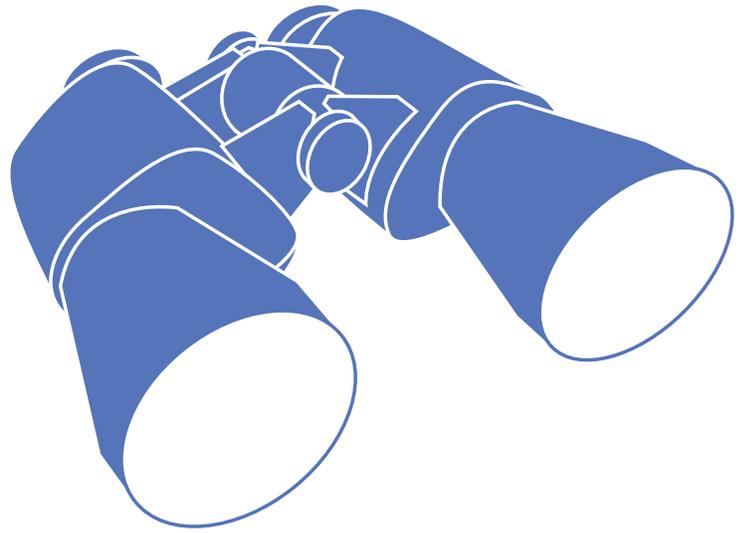
According to research where you focus your attention on and how you attempt to make change has a direct impact on the efficiency of learning and performance.

Most people naturally use internal focus and what most instructors, including golf coaches promote by giving instructions that refer to body movements. An external focus, on the other hand, is, like I said, a focus on the intended move and effect on say an implement.

However, what we must always keep in mind is that people are all different, and with that being said some people have a narrow external focus and some have a wider external focus. But the underlying evidence shows us that external focus promotes improved performance.

So for instance, if I throw a ball, it could be the spin I want to put on the ball, or I could focus on my target. In balanced tasks, it could be the object I am trying to control such as a bicycle or a motorcycle or skis or my intended path. In golf, there are a variety of things I could focus on externally such as the club, the club face, the target or hole, even the belt buckle or shirt buttons and so forth.

Often people wonder about why an external focus is so much better for performance and learning when we have a good idea of what happens when people focus internally versus externally. When you focus on body movements, you consciously try to control your movements and the result is that you constrain your motor system - meaning there will be unnecessary co-contractions between agonists and antagonists, and even superfluous contractions in other muscles as well.

That disrupts the fluidity of the movement, and people use more energy than necessary, and accuracy of their movements is degraded and so forth. Now, when you use external focus, you use more automatic control processes which are unconscious, much faster, and as a result, movements are more efficient, more fluid, smoother, and more accurate.

So, performance and learning is facilitated and sped up.

The focus farther away from the body at a greater distance is typically more effective than a focus that is close to the body, a proximal effect. So in golf, a more proximal focus would be, say, the club

face and a more distal focus would be, say the flight of the ball or the hole. And usually what we find is that performance is further enhanced by a more distant focus.

Yeah, that's a question and it refers to both; performance is often enhanced immediately when I focus externally as opposed to internally, but also the learning process is facilitated when learners adopt an external focus. So, learning is sped up, you reach a higher skill level sooner than you would with an internal focus.

The optimal distance of the focus seems to depend on the skill level. So for a highly skilled golfer, a more distal focus would likely be optimal, so, a focus on the target, the trajectory of the ball. But for a novice golfer, a focus on say the club or the club face is probably going to be more effective because they still have to learn the technique. So you know, one proximal focus is typically more effective for novices.

There are some interesting studies; for instance, a couple of studies looked at people who have Parkinson's disease and they found also that if you direct people's attention externally on balance tasks for instance, they do better, their balance has improved right away.

The same is true for people who had a stroke; in one study, people after stroke were asked to move objects like a mug or an apple from a shelf to a plate for instance, and just by directing people's attention to the object they were manipulating, rather than say their hands or arms, their movement speed was increased, movements were much more fluid, and so even after stroke, movement automaticity was enhanced by giving external focus instructions.

External focus really has two advantages: one is, it keeps people's focus on the target, on the intended movement goal, and two, it directs attention away from the self, specifically the body.

Human beings seem to have a propensity to focus on the self or to become self-conscious, especially under pressure or when they are not performing well, when they are being observed or their performance is being measured or evaluated. So it's easy to go back to that self-focus or internal focus.

The advantage of an external focus is really that if you are able to maintain it, you direct attention away from the self and again to the task/goal and so it really has a dual advantage.

Repetition Without Repetition

A wise quote was once published – "Repetition is the mother of skill" by Tony Robbins, which many attach to the "We are what we repeatedly do" from Aristotle.

These are incredible quotes, and are 100% true, correct and magnificent. However, the golfing population and many instructors out there have been misled or have misinterpreted them.

There is a distinction between what exactly is to be repeated.

Mere repetition of a movement does not ultimately mean with 10 thousand more repetitions I will be good at this move. It doesn't mean that the move will become imprinted in one's mind and forever in their ability to execute upon desire.

Dr. Richard Schmidt published an incredible paper based on P.A.R (Planning, Acting and Reviewing) and it can be described as a whole skill. Remember skill, by definition, is the ability to do something well. So planning a movement, executing the movement and reflecting on the outcome of the movement is the whole skill broken down. Here is where the repetition part comes into play.

By repeating this whole process we learn and our skills improve, so repetition is the mother of skill.
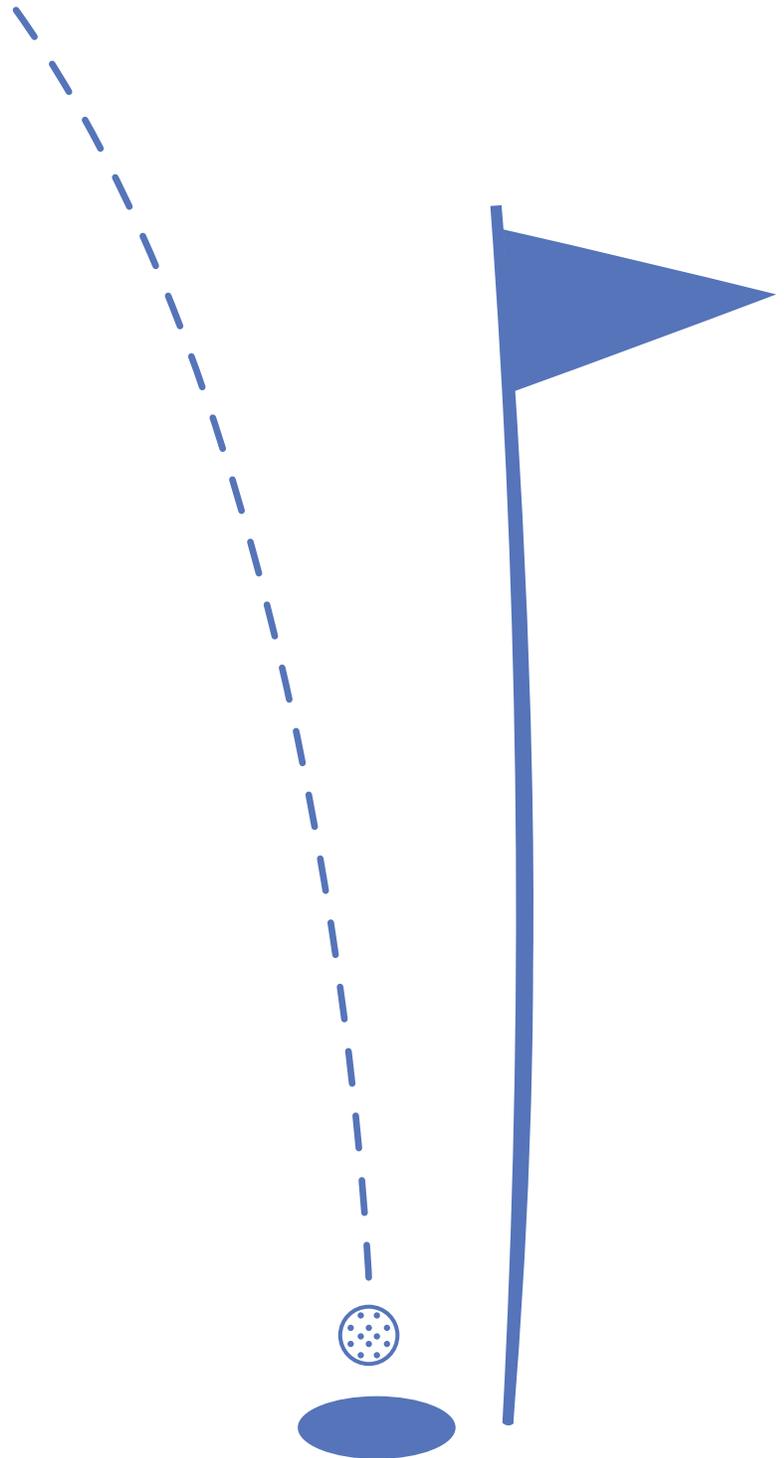
But repetition of the whole skill is the only repetition that will help golfers.

Conclusion

Hopefully, by now you have some ideas about
how you can improve your learning and practice environments
for better long term learning and improvement.

One part of the problem is the knowledge. Which hopefully
you have an introductory understanding of it now.

The second part is action. Commit yourself to making a change to
start learning and practicing more efficiently. If you do that you'll see improved
growth and your skills improve as you begin to effectively practice and learn.

ABOUT:

I hope you enjoyed this collection of motor learning advice.

At the Golf Science Lab we're talking with academics
and researchers and bringing that information to you.

And don't forget to write me an email and let me know
the impacts of better practice and learning habits have had
on your game. I read every email.

Thanks for reading,

– Cordie

Email me at hey@golfsciencelab.com