

CREATING A METHODOLOGY FOR
TEACHING THE GOLF SWING

by

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Mission Statement

There are two particular aspects of learning, rather than actually teaching, that will be advanced throughout this thesis:

One, that an efficient golf swing, as with any motor skills, is best achieved from within.

And

Two, through a general understanding of the laws of physics governing the golf swing we can optimize the learning process.

An Overview toward the Teaching of the Golf Swing

"We cannot possess something we do not understand."
by 18th century writer Johann Goethe.

In my view, too often instructions of the golf swing are presented to students built upon some false pretenses. This thesis will attempt to dismantle these falsehoods on the basis of what scientific evidence gathered over the past three decades has proven -that the golf swing is a motor skill, which according to eminent authorities including Master Professional Mike Hebron, "cannot be taught, but can be learned."

While this may seem to be simply a question of semantics to many in the golf industry, the lack of understanding of what constitutes a motor skill and how it should be dealt with has some wide ranging implications toward the teaching of a golf swing.

Golf instructors often surmise that when they instruct a student, the student's brain is in a state of consciousness. As the student continues to practice and repeats the actions of the instructor, the lessons learned will flow into the unconscious state of the brain. It is at this point, derived through repetition, that the instructor assumes the student has the understanding needed to progress.

Repetition does indeed play a role in the learning of all motor skills, but it is unfortunately not the only means or even the fastest way to achieve results. If an instructor teaches a lesson without altering the individual's perception of why an action takes place -contained within the student's brain- then the student is apt to slip back into their previous state of remorse, which is why they originally sought professional help.

One cannot build a solid golf swing without first having some comprehension of the actions taking place. Golf instructors must not put the cart before the horse.

These professionals who instruct a golfer on "how to" hit the ball through simple adjustments in the mechanics of a swing are attempting to build a solid golf swing under false pretenses.

Golfers of all stripes, already possess some preconceived notions of a golf swing. Even the beginner who professes to have no previous knowledge of the game, has an inherent understanding that in order to play the game they must swing the golf club to hit the ball. What they lack may appear to be the mechanical aspects of an efficient swing, but what is really missing is a true understanding of the actions within the swing or why things occur.

Improvements can be achieved through some mechanical changes, but ultimately golfers will be limited in their results. A faster and much more efficient method of teaching is achieved through altering the student's perceptions and thus ensuring that the improvements are longer lasting since being impelled into their brains.

As an example, countless golfers and professionals assume that to increase distance they must improve the power of the golf swing through increased clubhead speed (see "Relaxing for Distance" under explanation for a detail approach to this lesson). While there is truth in this statement, failure ensues when they attempt to garner this added speed through the use of potential energy (or muscular strength).

This perception actually hinders the golfer from maximizing his potential by restricting the actions of the muscles and thus the Kinetic Energy (or the energy of movement) at force in the golf swing. In order to maximize the speed of which the clubhead is moving, one should first have a basic understanding of the scientific forces at work. Without this understanding, golfers are limited in their perception and thus their brains are not empowered to swing the club to its maximum potential.

Another very important aspect of teaching can be found in the terminology used while teaching, it is for this reason that there are certain phrases that I will avoid using throughout this paper. These phrases give the wrong impression of what is happening in the swing. As an example, golfers do not "hit the ball" rather the clubhead makes "contact with the ball" in the course of the swing. This might seem like another point of semantics, but it must be stressed the importance of the instructor presenting the proper perception to their students.

Next, it is important to understand the concept of cause and effect. When a golfer attempts to keep the clubhead on line throughout the swing, he infringes upon the natural flow or the dynamics of the actions taking place and thus encroaches on speed of the clubhead and the direction the ball will follow.

To underscore this infringement, look at a player preparing to putt. It has often been said that the greatest problem is in decelerating the putter head through the ball on short putts.

Instructions have asserted that on short putts, one should keep the grip light and hold the putter on line -straight back and straight through. This corrective measure focuses too much attention on the backswing. Because of the player's position to the ball, they will more often than not force the clubhead outside or inside the line resulting in a pulled or pushed putt, respectively.

There is no free-flowing action in the swing because of muscle constriction, resulting in the dreaded Yip. The Yip is directly related to the muscle freezing up due to the lack of dynamic balance in the swing caused by the player attempting to keep the putter head on line throughout the putt.

In fact, every time a person causes an action to take place, we say he is in a cognitive state of consciousness. This is not to imply that we should not be in this state at certain points in a round. When deciding what club to use or the path that we want the ball to travel, a good golfer is said to be in a cognitive state of awareness.

When the golfer gets over the ball, if he is still in this state, the swing becomes convoluted and his actions result in a poor shot or not coming off as planned.

The greatest players will tell you that when they are playing their best, they find they're in a special zone or an almost unconsciousness state. There are no checklists to go through or mental images that they must call upon to perform and, yet, they are very much aware of what is happening in their surroundings.

It is this awareness that is a function of learning. They are not in a result oriented mode, but they are still very aware of the effects the wind might have on their ball or how the green slopes or will be effected by the firmness or softness of the green.

Being aware allows for understanding and it is this understanding that leads to the improvements of the swing. Without one there can not be the other. Teaching a golfer "how to" swing rather than improving the "why" things occur hinders the educational process and limits the learning experience.

Method for Teaching A Motor Skill

With the concept that the golf swing is a motor skill, it is necessary for the golf instructor to understand that his vast knowledge of the swing cannot begin to tell the student's body what to do.

The instructor can only assist the student in a discovery process. Since the student's brain is in control of their bodies motions, it is their brain that has to receive the proper information in order to perform an action the instructor is attempting to prescribe. Hence the use of scientifically based and proven facts to ensure that the student's brain receives all the pertinent information required to perform well.

Throughout the ages, some golfers have relied heavily on their athletic ability and natural coordination to compensate for any inherent idiosyncrasies or short-comings of an inefficient golf swing. This is a simplistic explanation of why many of these players go into prolonged and sometimes seemingly endless slumps.

Since no two golfers have the same swing or even the same perception of what is required in an efficient swing, instructors must first construct a method that will satisfy the students curiosity before any learning process can begin.

In the learning process, the golf teacher must assume a coaching role. Their responsibility is to assist the student in the discovery of the various components of an efficient golf swing. They must promote and reinforce in their student's mind an understanding of an efficient swing.

In order to help the student in the learning process, I have adopted the following procedure as a guide for instructions. It encompasses, what I call "The Four Stages of Learning" which is similar to the method used by the educational field for many years.

Included among these four stages are :1) Explanation; 2) Demonstration; 3) Execution; and 4) Feedback

Some of these stages, which are described in detail later, have been used in the traditional method of teaching by golf instructors. But while each stage, in and of itself, can bring about some improvements in the golf swing, it is only through the totality of all four stages that a student can begin to perceive, interpret and process the information through his or her own brain.

The brain, which controls the body, can then transmit the information to the various muscles to reproduce an efficient golf swing. The more objective or scientifically based the information is, the greater the understanding and quicker acceptance by the student.

1) Explanation

The explanation stage should be kept as brief as possible. Studies have shown that language can be a deterrent when students are learning motor skills. The farther language intrudes into the golf classroom, the greater the potential for misinterpretation.

In this initial stage, the instructor should identify the subject of the learning session for the student. For example, the subject matter for a first session will include the posture and grip that a student must assume in order to achieve phase one of the program: How Kinetic energy, created through movement which occurs during weight transfer, swing of arms, club weight, and configurations of this weight, along with inertia, centrifugal force, conservation of angular momentum (CAM) and the laws of acceleration, is generated in an efficient golf swing. Essentially, the golf swing is an action which is initiated by the student and ends with the student permitting the laws of physics to flow unimpeded, allowing the club to do its job.

*** An example of one lesson that could be titled "Relaxing for Distance" or "How is the Energy Created in an Efficient Golf Swing"

Every golfer would like to achieve a powerful golf swing. Unfortunately, golfers confuse power with swinging the golf club harder. They inherently grip the club tighter causing the muscles in the hands and arms to constrict and thus actually reducing the clubhead speed at the point of impact as well as taking the clubhead off plane.

The key is in recognizing the different aspects of increasing the power of the swing:

A. Gripping the club should be with the fingers not the hands. Hold the club in front of you with the clubhead skyward. Form the grip with your fingers -looking into a mirror you will notice that the first three knuckles are in-line with the last three knuckles of the other hand? By having them in alignment, it allows for the hands to respond to the swinging golf club throughout the swing and reduces any tension. Bring the clubhead down to the ground and your hands are set.

B. Allow the arms to hang freely from the shoulders and avoid creating any tension in this area. Tension will restrict the amount of turning in the upper body and of your body trunk, thus reducing clubhead speed, which limits the distance the ball will travel.

C. The upper body should rotate around an axis at the nape of the neck or top of the spine. To keep this axis centered, the lower spine moves laterally with an upward tilting of the hips -the right hip tilts upward on the backswing, and the left hip tilts upward on the downswing. Any lateral movement of the upper spine will result in inconsistent clubface-to-ball contact and can actually reduce the length of the swing.

These three simple steps should allow you to swing with greater comfort and generate better clubhead speed. The ball will be propelled further and straighter with seemingly less effort. The more relaxed you feel when hitting the ball the more confidence you will gain.

2) Demonstration

Since the human brain is said to receive more than 85% of its information through the eyes, the instructor should pitch some balls with a short club so that the student can follow the slow swing and observe what is happening as the swing is in progress. Bearing in mind the old adage "that a picture is worth a thousand words," this exercise can be usefully reinforced with photographs, video tapes and other visual aids.

Throughout the entire session, the instructor should emphasize the absence of muscular tension -from the easy grip, where the fingers support the club, to the follow through- all of which he has already covered in the explanation stage. It cannot be overstated how vital it is at this point that the student understands and assimilates the correct perception of what is taking place in order to perform correctly themselves.

Perception is the most critical aspect of this exercise where the instructor must be sure that the student is developing the correct one.

It is at this point that the student will witness the inter-action of the six pairs of body joints coming into alignment and positioning themselves in a natural manner to promote the efficiency of motion that is being created through centrifugal force during the swinging of the clubhead.

The six body joints referred to above include: the upper three pairs -the shoulders, elbows and wrists; and the lower three pairs -the ankles, knees and hips.

3) Execution

At this point the student is invited to execute a basic drill that will help him understand, through clubhead feel and ball flight, the importance of creating Kinetic energy. The above drill is performed by flexing the left knee toward the ball causing the right knee to extend backwards, but not to a locked position (this was described in the explanation stage). This move causes the weight shift to the right heel permitting the lower spine to move and line up with the right leg forming an axis that permits the upper body, shoulders, ect., to turn to the right on an oblique plane. Due to the absence of muscle contraction in the arms, they will rotate under the influence of the off-set weight of the clubhead to the top of the backswing.

As the club starts to slow down and stop at the spot dictated by the flexibility of the individual, the golf club weight or mass is increased tenfold. The inner ear that helps balance the body becomes involved at this juncture and a simple reflex action causes the body to naturally shift its weight to the left side to regain balance. This phenomenon generally starts before the arms have completed their backswing track. It is often described as point zero, where the individual overcomes the natural effects of inertia.

A simple method to use in reinforcing this concept and to show the student what they will feel as they reach point zero is to have them close their eyes while performing the backswing. As the clubhead reaches point zero they will invariably sense that they are going off balance and open their eyes in shocked amazement. This is the point of transition that has, too often, been hurried and the point where instructors inform their students to "pause at the top," instead of allowing the natural reflex action of the body to react.

It is important to express to the student how the lower three pairs of body joints -the ankles, knees and hips- by being properly set up, effect the upper three pairs of body joints in their reaction to the momentum generated by CAM and the laws of acceleration.

4) Feedback

Upon completion of a learning session, the student is asked to give their observations on what they have learned. Both verbal and written comments are equally valid. The verbal comments are sought for the immediacy of the student's reaction. The written comments are required for the added reflection which goes into this exercise. On either side of the practice tee, feedback is critical to advancement. The student reveals to the instructor, regardless of his or her performance during the execution stage, how they have interpreted and internalized the lesson's material.

This is the stage that the golf instructor learns what must be done to reinforce the skills of the student in question. Each student's response will be different, but the instructor will often see a pattern forming in their replies.

This stage helps to evaluate the lessons learned and dictates to the instructor whether the student can advance to the next level or if elements were not received and require further attention.

This provides for :

- 1) a monitoring system by which the instructor can evaluate whether the student is internalizing the lesson.
- 2) it allows for the reinforcement of the student's memory.
- 3) it lets the student create their own book of instructions from their perceptions allowing them to diagnose a problem in their swing when performance is not up to expectations.

To encapsulate this stage of instructions it is simply a form of communication between both student and teacher.

All four of these stages, if used in unison, will bring progression in acquiring a golf swing. That being said, there will be times in the learning process that a student will seemingly level off. These plateaus of learning are to be expected, if one understands the learning process, particular in acquiring a motor skill. Although the performance may have reached a certain platitude, the learning process is still on-going.

Laws of Physics Inherent in the Golf Swing

The laws of physics govern all components of the golf swings. The principle elements that we are most concerned with are in regards to force and motion. Too often, golfers of all ability attempt to defy these laws because they don't understand the elementary principles involved. What I hope to convey here is some of the principles of movement that take place in the swing and a brief description of each element and how it relates to the swing.

Motion

About three hundred years ago Sir Isaac Newton, an English scientist, formulated many laws in regards to motion. One of them states: An object at rest tends to remain at rest unless some force causes a change.

A force, as used by scientists, is either a push or a pull. In other words, an object (the clubhead) which is not moving will remain that way forever unless it is moved by muscles, gravity, wind, explosions or other force natural or unnatural.

When a force starts to be exerted, the object starts moving slowly at first. This is because the object resists being moved. This tendency to stay in the same place is called inertia.

Inertia

There are two elements of inertia. One which occurs while an object is at rest and the other while an object is moving.

It is in regards to this second element that Newton's law of inertia states: An object in motion tends to continue in motion, at the same speed and in the same direction, unless some force causes a change.

Inertia, then is the tendency of moving objects and stationary objects to continue what they are doing. In a golf swing, inertia plays an important role.

At the beginning of the swing we must impart a force to overcome the initial inertia from the clubhead at rest. Then as the clubhead gets mobile, we must overcome the second element or its reluctance to stop at the top of the backswing in order to change directions.

At the top of the backswing the clubhead has again come to rest and it must be pulled into action in order to make contact with the ball. This is the point where we earlier described how the golf club weight or mass was increased tenfold. The inner ear that helps balance the body becomes involved at this juncture and a simple reflex action causes the body to naturally shift its weight to the left side to regain balance. This phenomenon generally starts before the arms have completed their backswing track. It is often described as point zero, where the individual overcomes the natural effects of inertia.

This transfer of weight to the left side allows the golfer to overcome the inertia at this point and provides the initial descent of the club.

Fulcrum or Axis

In order to create a proper rotational maneuver to overcome inertia it is important to find an axis or fulcrum. This axis is formed at the nape of the neck or top of the spine. To keep this axis centered, the lower spine moves laterally with an upward tilting of the hips -the right hip tilts upward on the backswing, and the left hip tilts upward on the downswing. Any lateral movement of the upper spine will result in inconsistent clubface-to-ball contact and can actually reduce the length of the swing.

A golf swing can also be described as a lever system in which a fulcrum is placed between the load and the effort. Because the fulcrum is so far off-set away from center, a lot of muscular effort must go into the grip of the club at one end in order to move the clubhead at the other. Even greater effort is required to achieve the same results if the individual is at all off-balance.

Centrifugal Force

This is a natural force created by the off-set weight inherent in the design of the clubhead. With more weight concentrated toward the toe

of the clubhead, the club on a downward path is thrown out toward the ball and away from the body.

Gravity

Because of the trajectory of the club during the swing the gravitational pull also effects the path which is dictated by centrifugal force. It is only when a golfer attempts to change the directions the club is traveling in is a shot mis-hit. When a players pulls up before the point of contact -resulting in a topped shot- or increases the point of descent -resulting in a fat shot- it can be deemed that they effected the natural elements in the course of the swing.

Duration of Force

It is obvious that the longer a force acts on an object to speed it up, the faster it will move. Suppose a golfer is preparing to contact the ball. At the instant he starts his downswing, the club is moving slowly. The longer he can swing the club before releases it toward the ball, the faster it will move.

Good players always continue their swings as long as possible. This is called follow-through. It makes force act longer on the ball to make it go faster.

There is also the phenomenon of speed weight and impact. A lighter weighted club traveling rapidly can impart as much hitting force on a ball as a heavier weighted club traveling slower.

These effects are due to momentum. Stated simply, a moving object's momentum is calculated by multiplying its speed by its weight. A two iron with its longer shaft but with a smaller head will impart the same amount of force as a heavier pitching wedge with a shorter shaft.

The reason for this is the momentum generated by the added distance traveled. The force by which the ball travels is the same in both instances but because of the degrees of loft the balls travels on a different trajectory.

Action and Reaction

Another very important law of motion can be stated: For every action force there is an equal and opposite reaction force.

Strange as it may seem, whenever you exert any force upon an object, the object exerts a similar force upon you -but in an opposite direction.

When the club makes contact with the ball, the ball exerts an equal but opposite force upon the club. Two objects are always involved in reaction. One body can never exert a force upon another one without

the second's reacting against the first. The reacting force is always equal.

Potential and Kinetic Energy

Potential energy is the stored energy possessed by material because of their position or condition.

When the arms extend during the backswing it can be determined that they are gathering potential energy. There is also potential energy being generated through torque which is derived through the coiling and uncoiling of the body and the club arc.

Kinetic energy, or energy of motion, is sometimes known as active energy. It is the form of energy that all moving objects have.

The release of potential energy results in the formation of Kinetic energy. If enough potential energy has not been collected from the backswing, no greater amount of Kinetic energy can be generated by trying to apply more force on the forward swing.

Conservation of Angular Momentum

The conservation of angular momentum (CAM) occurs when the hands start to slow down and the clubhead goes into acceleration.

In the early stages of the downswing, the original momentum gives the arms and hands considerable speed. The inescapable law of CAM begins to operate as the rotational speed of the arms slow down.

The slowing down process of the arms is an important indication that the momentum generated in the beginning has been fed into the club. The speed of the club in the final stages of the downswing and the clubhead whips through its last quarter-circle and catches up with the hands at the ball. The clubhead has to catch up with the hands as a matter of mechanical law -the momentum once generated, remains a constant amount regardless of how it is distributed.

A Goal to the Future

In the past professionals taught their students to play golf the way they thought they themselves played, or the way they were taught by the professionals under whom they served their apprenticeships. This traditional method was too subjective to be satisfactory. There were, in fact, as many methods as there were teachers.

The sum of all golf teacher's knowledge has been made up of what they learned in their own individual lives. Their knowledge has come from many different sources including intuition, common sense, tradition and personal experience. The professional who uses a particular teaching method because that is the way he was taught is basing his knowledge on personal experiences, alone.

Individual knowledge and experience differs from one person to the next and is thus, necessarily, subjective; however, this does not invalidate the benefits the personal experience can add to the learning process. Some degree of objectivity is necessary to temper the all-important experience and knowledge of the teaching professional. Together, both will provide an effective teaching method that could be adopted universally by any teaching professional.

Elements of Why

The golf swing begins primarily with the hands. It is the only link between the golfer and the club which is to be impelled through the ball. This makes it one of primary importance of the swing. Whether one uses the interlocking grip, the overlapping grip or a ten finger grip is of less importance compares to the positioning of the hands on the club handle.

Since both hands are working in conjunction to swing the clubhead through the ball, it is a must that the golfer understands the importance of the grip. Some professionals have advocated the strong grip while others prefer the weaker grip, but in order for the proper hinging of the hands throughout the swing a neutral grip -where neither side (the lead hand or trailing hand) is more dominant- should be promoted.

The reason is simple. With a strong or weak grip, the hands can not follow the natural path dictated by the laws of physics inherent in the swing. The golfer does not reach the fullest extent of the potential energy created in the backswing because the hands can not hinge and unhinge properly. While this does not stop the golfer from making an adequate pass at the ball, they do not begin to realize the fullest potential that can be achieved if the hands were able to react freely and unrestricted.

By the use of a neutral grip, the hands work together garnering the greatest amount of potential energy that can be converted into kinetic energy while swinging through the ball. This adds to the free flowing swing that is apparent in many of the longest hitters.

It also enhances the feel of the swing as the action is taking place and ensures that the clubhead takes the path of least resistance to reach the fullest potential. Athletic ability and agility also plays a role in a golfer reaching the fullest potential, as when a player ages and the swing becomes a little restricted, but by positioning the hands in a neutral position on the handle of the club, it can limit the differences

Identification Process

It has already been substantially established that there are elements in the golf swing that are not visible to the naked eye. This made it necessary to gather scientific evidence in order to understand the process of an efficient golf swing.

Through the solicitation of Professor Jacques Dessureault of the physical education department of the University of Quebec at Trois Rivières, whose expertise lies in the field of biomechanics -the study of mechanics in an inanimate structure- a series of lessons were conducted. These lessons were an attempt at trying to isolate the source of energy within the golf swing. Unfortunately, Professor Dessureault was unable to identify the source, but recognized the existence of this energy.

The first scientific explanation of this energy came from *The Biomechanics of Power Golf*, a video presentation featuring the pioneering research of Dr. Gideon Ariel. His research proved that part of the energy source in a good golf shot came from the weight being transferred from one foot to the other, a weight shift that invokes the law of acceleration, "for a force to start there has to be a force that stops," or in a single word, momentum.

In the golf swing, the force that stops is the weight of the body being transferred to the left and running into the left foot and ankle joints on the downswing. This movement drops the arms and hands setting up the conservation of angular momentum (CAM) potential. As the hands drop down on plane they start to slow down and the clubhead goes into acceleration.

Further evidence of CAM was identified in the book, *The Four Magic Moves to Winning Golf* written in 1962 by Joe Dante and Len Elliot in collaboration with Dr. Ira M. Freeman, Professor of Physics at Rutgers University. They appear to be the first researchers to identify the mechanical principal governing the action of the club in the last quarter of the downswing as CAM.

When CAM is applied to the golf swing, this is what happens: the player and the golf club together becomes a unit that forms a mechanical system. The mass consists of the golfer's shoulders, arms and the club. The axis of rotation is the top portion of the spine, midway between the shoulders. As the backswing reaches the top, the extensible part of the mass (arms and club) is quite close to the axis. Then when the hips make their lateral movement to the left, the shoulders turn and tilt sharply, supplying the original momentum that starts the downswing. The downswing, of course, is the rotational action in which we are interested.

Immediately, the arms start down and as they do, they begin to move away from the axis. In the early stages of the downswing, the original momentum gives the arms and hands considerable speed. The inescapable law of CAM begins to operate and the rotational speed of the arms slows down.

The slowing down process of the arms is an important indication that the momentum generated in the beginning must have gone somewhere else. It has! It feeds into the club. This, in turn, increases the speed of the club in the final stages of the downswing and the clubhead whips through its last quarter-circle and catches up with the hands at the ball. The clubhead has to catch up with the hands as a matter of mechanical law -the momentum once generated, remains a constant amount regardless of how it is distributed.

A perfect illustration of this mechanical law takes place during the execution of a pirouette by a figure skater. As the spinning skater brings their arms close to their chest, the momentum generated is transferred to the part of the system with the lesser mass, the part easiest to move, the tip of the skate contacting the ice.

Another example of this phenomena occurs during the lashing of a bull whip. The momentum, in this instance, is distributed from the arm and hand to the heavy butt of the whip into the steadily tapering lash to the light tip. The tip has the least mass and is the easiest among the chain of items in motion to move. The tip travels so rapidly -over 800 miles per hour- that it breaks the sound barrier and causes the whip to crack. This same principal, when applied to the golf swing, causes the clubhead (least mass) to catch up with the hands while executing a shot.

Dr. Michael H. Austin, recognized as the pioneer and foremost kinesiologist as applied to golf, has spent much of his career applying his knowledge of kinesiology, anatomy, physiology and physics, to the golf swing. Among his credentials, he has won 48 long driving contests and is in the Guinness Book of World Records for the longest competitive drive of 515 yards at the U.S. Senior Open championships in Las Vegas at the age of 64.

Dr. Austin says that when you learn how to use the joints of the body according to their design, you get efficiency of motion.

"It is important to understand the kinematics of the golf swing and that the foundation upon which the swing is built is the coordinated action of the bottom six joints of your body: the two ankles, two knees and two hips. The upper six joints of the skeletal frame sets the cocking of the wrists and the plane of the golf swing. This action is followed by the flexion of the right elbow and the radial flexion of the wrists on the backswing between the elbows around the top distal end of the right shoulder. On the foreswing the uncocking of the wrists is between the elbows and because you turned your forearm 90 degrees to get upon the oblique plane on the backswing, you must, before you return to the impact position, return your arms to the position that they were in when you initially addressed the ball. In concert with the backswing and foreswing action the legs initially position the body into a very strong position on the backswing and then reverse this action on the foreswing to position the body in a very powerful and balanced position at impact." (Quoted from an unpublished article by Dr. M Austin)

The scientific explanation, while bringing a better sense of understanding of the action within the golf swing, did not indicate how to translate this knowledge to a student.

At this juncture, PGA Master professional, Mike Hebron introduced the concept of a golf swing as a motor skill in his book, *The Art and Zen of Learning Golf*.

Mr. Hebron indicated that all successful golf shots involved the use of motor skills. Since no one can play a consistently good game of golf without mastering the motor skills inherent in swinging the various clubs and hitting the ball, and given the fact that the necessary motor skills cannot be taught in the traditional fashion, a new methodology needed to be developed.

Moving Forward

The scientific data gathered from the works of these researchers, while enlightening in their comprehension of the golf swing, didn't begin to wed the scientific understanding with a methodology of learning. In order to facilitate the creation of a teaching philosophy, it was necessary to understand the field of sports coaching. Through the marriage of science and the information already available to coaches of other sports, a concept could be developed to train golfers.

Sports training becomes progressively more fine-tuned as teachers develop their analyses with the help of biomechanics and kinesiology. For the student, however, the overall importance of the lessons drawn from the application of kinesiology and biomechanics is to allow their bodies to function as a whole unit, and not as a separate and disparate collection of parts.

Concluding Thoughts

The golf swing is a practical application of physics. Physics is the science of the phenomenon of inanimate matter involving no chemical change. More simply, it is the study of the strange and seemingly unaccountable occurrences which involve inorganic matter. The laws of science that govern the golf swing (the laws of motion) cannot change, but the way professionals interpret these laws to their students are very personal and should be both innovative and creative.

Teaching professionals have, quite correctly, but without necessarily knowing why, been exhorting to their students for years to let the club do the work. But in learning a motor skill, the student needs to understand first and foremost, why, or the student will not be able to assimilate the information and create the proper perception.

Perception is the most critical aspect of the golf swing to both the student and the golf professional. Without the correct perception, the student cannot perform the appropriate movements which will allow his swing to develop. In order to learn and reproduce the desired motor skill, the information must be perceived, interpreted and processed by the brain before the brain can transmit instructions to the various muscles to mimic the perceived actions. It is obviously vital that the information transmitted to the learner be correctly and reliably communicated, and that the golf instructor, in turn, sees that the student has correctly interpreted the given information. The more objective the method, the higher the degree of reliability.

Science provides us with the objective base upon which a bank of empirical data can be built, providing a more solid foundation to the teaching professional than anything that mere experience or intuition alone can supply.

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