

Geoff Mangum's PuttingZone™

Optimal Putting

*Brain Science, Instincts, and
the Four Skills of Putting*



A New Paradigm for
Putting in the 21st Century

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Quantum Putters — *The New Technology in Putters*.
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Optimal Putting

Dedication

To Anne and our family:

*Wrongs never righted,
Kindness too often slighted,
We stumble along in the grace of love.*



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"You have great putting tips, especially the ones about the gaze. Let's meet and work together when I play Charlotte in May [2003]. I know if I can just get my putting improved, I can break through and win."

["Everyone remembers my seven iron, but my putter won me the PGA Championship [July 2003]."]

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Director of Golf

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"Geoff Mangum is a genius in putting instruction. After two short lessons, I've never puttied better in my life."

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President, Carolinas Section, PGA of America

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"Geoff has more knowledge and expertise about putting than any other person that I know. He is an outstanding teacher and his philosophy is backed with an enormous amount of research. He's definitely at the top of the class."

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"I personally enjoyed your presentation to the European PGA Teaching Conference very much. I learned a lot."

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Tim Parker
Head Pro, Gut Waldorf Golf Club
Hamburg, Germany

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National Research Director
Neuro-Optometric Research Assn

"This is very good! You have such a vast store of putting knowledge that it must be very difficult for PGA teachers to appreciate how much you can help them. I've never heard most of what you teach."

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PGA Master Professional

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Preface

Invitation to the reader:

This book is about optimal putting, combining the best golf techniques or lore from history with modern neuroscience for the perceptual and movement processes in the four skills of putting action. The materials covered are based upon twenty years of research and study into the history of putting instruction, the styles and techniques of the great players in history, and the neuroscience and other fields of science (anatomy, biomechanics, physics, psychology, kinetics, and the like) bearing upon the issues of perception and movement during putting. This study indicates that there are four fundamental skills for putting — reading, aiming, stroking, and controlling distance — but that conventional golf lore seriously addresses only the stroke, and leaves the other three issues largely unexamined. My investigation into neuroscience and other fields of science outside golf is solely for the purpose of answering the simple questions of how these skills work in terms of the golfer's body and brain on the green.

Because in my view conventional golf instruction leaves golfers and the game itself woefully uninformed about the know-how for the four fundamental skills of putting, the current book may well strike average golfers used to “slice and dice” instructional fare as overblown if not pretentious. I apologize to these golfers, but this specific material unfortunately could not be written for average golfers in the style of magazine tips.

At this point in time, what is needed in golf is a book written for the serious elite and professional golfers and golf teachers that attempts to clarify and integrate a confused and vague subject representing nearly half the game.

“Science should be as simple as possible, but no simpler.” The instincts and the non-conscious processes of the human brain

are not simple at all to discuss or explain, even if the use of the instincts in the everyday act of picking up a glass of water off a table appears to occur in a very uncomplicated manner. In order to fuse golf lore with neuroscience for the instincts, it is necessary to explain some issues in a degree of detail usually unsuited for sports enthusiasts. This is unavoidable, but I have tried to bring to bear whatever meager talents I may have as an explainer of complex subject matter for the benefit of a general audience. Subsequent books are planned for the beginner and the casual golfers. All in good time.

And this book is also not about putting in general, but about optimal putting for golfers at any level of expertise. The overarching approach is that simple is better than complex, and that instinctive and non-conscious movement based upon focused, accurate, relevant and rich perception is better than analytical and conscious movement based upon casual, indifferent, irrelevant or inaccurate perception. Putting techniques that are founded upon innate perceptual and movement processes of the brain and body, and that complement and enhance these processes rather than conflict with them, represent "fundamentals" for putting for all golfers for accuracy and consistency. And without a solid base in putting fundamentals, intelligent choices and optimal performance are simply not in the cards. I term this approach "The Mechanics of Instincts" to underline how golfers can know and appreciate the processes of instinctive movement for application on the green in the process of putting mastery and attaining the highest skill level possible.

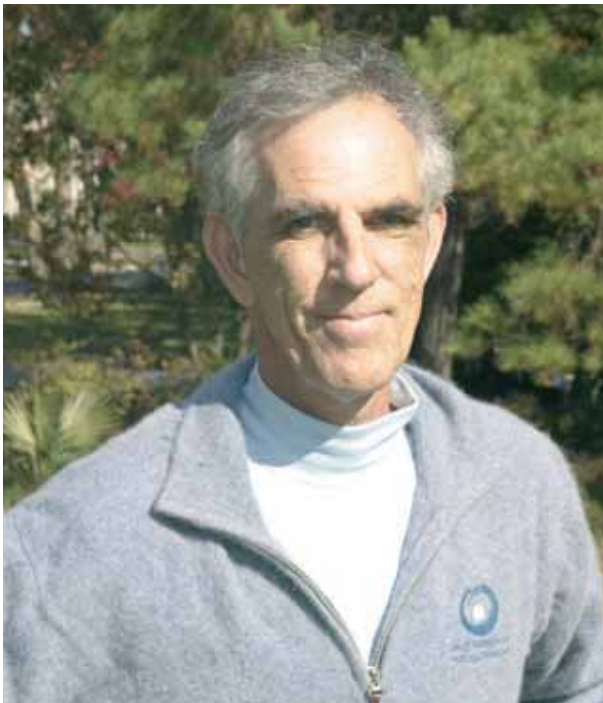
To the extent this book appears to reject or ignore what many consider to be legitimate techniques for this or that aspect of putting (e.g., looking at the hole while making the stroke, so-called "zen" techniques for putting, odd grip forms, etc.), my plea is to regard this book as a synthesizing of constant and fundamental themes and techniques into an integrated system. In this process, many ad hoc and idiosyncratic techniques are

left by the wayside. This is not to say these techniques lack value or would not have some beneficial effect in a specific golfer's game, but it is my position that such techniques do not strike at the heart of the matter for a system of optimal putting.

Even with that said, I cheerfully invite interested beginners and casual golfers to peruse this book to whatever extent their personal interest level dictates. I have taken some pains to organize the whole in a simple arrangement of the four skills, so there are plenty of opportunities for dipping a toe into the waters here and there in the text.

*Go, little book,
among the peoples of the world
today and in the times to come,
and there find friends.*

Geoff Mangum
Greensboro North Carolina USA



Optimal Putting: Brain Science, Instincts, and the Four Skills of Putting



Chapter 1: “Mechanics of Instinct”.

Putting is the “game within a game” of golf that comprises nearly half of all strokes for every round ever played, and the putter is typically used more than twice as frequently as the driver. The history of golf instruction for putting dates roughly to 1904 with the publication of Walter Travis’ book *The Art of Putting*. Today, there may be as many as 40 titles currently in print for putting. But in total, there have been fewer than 150 books ever written in English focusing upon the art and science of how to putt, whereas in contrast a count of only those “swing instruction” titles currently available is nearly 4,000. The same pattern is reflected in the golf magazines for instructional content, with a ratio far in excess of 100:3 or about 97% to 3% in favor of the full swing over putting. And it has ever been thus.

One can speculate about the social and historical reasons for this gross imbalance in the sport of golf, but it does little good. What is most needed is simply to get on with contributing to this other half of the game.

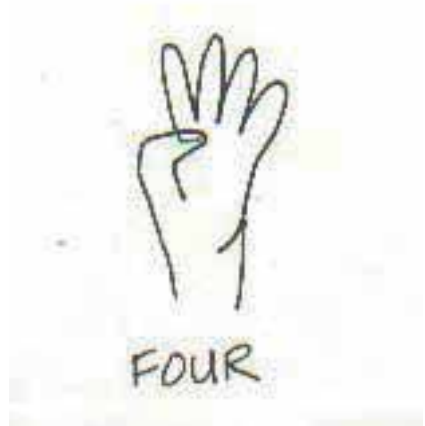
Fundamentally, the four basic skills every golfer needs to master for putting are:

1. **READING THE PUTT:** pick an effective target to aim at and to putt as far as or to, serving both line and distance;

2. **AIMING THE PUTTER FACE AND BODY:** aim the putter face and the setup straight at the target;

3. **ROLLING THE ROCK:** putt straight away from the putter face on the same line as it aims at address; and

4. **CONTROLLING DISTANCE:** putt with good touch, weight or distance control so the ball always arrives with the same terminal speed at the hole regardless of the putt lengths.



CONVENTIONAL LORE.

Surveying the whole of published golf instruction for putting since the 1880s (books, articles, videotapes, DVDs, etc.), one is impressed by the fact that golf lore for putting has never seriously engaged three of these four skills (reading putts, aiming the putter, and touch), and even the treatment of the stroke is replete with vagueness, inconsistency, confusion, and repetition. At best, golf instruction for putting is largely the ad hoc reports of “what seems to work for me” presented in the

vacuous terminology that pervades the sport — terms without functional meaning like “touch,” “feel”, “pace”, “release” and the like — leaving instructors not defining their meaning and students not agreeing on the message.

Conventional Lore:

“Putts account for approximately 50 percent of the strokes taken in making par for a round, but seldom does the average golfer give 5 percent of his time in the study and practice of golf to putting.” — *Golf Magazine’s Handbook of Putting* (1973), 61.

“After a fair amount of proficiency has been acquired in the use of the cleek, iron and mashie, we have the difficulty of putting to surmount. And here I may say at once it is an absolute impossibility to teach a man how to putt.” — J.H. Taylor, 5-time British Open Champion, in Palmer, Arnold & Dobereiner, Peter, *Arnold Palmer’s Complete Book of Putting* (New York: Atheneum, 1986), 134.

Reading Putts. Only one book has ever been written addressing the science of reading putts, H.A. Templeton’s *Vector Putting: The Art and Science of Reading Greens* (1984), and this book has long been out of print and remains almost completely unknown by golfers and golf teachers. The golf lore for reading putts consists in little more than well-worn rules of thumb about reading “grain” or “imagining pouring a bucket of water on the surface”, and does not include discussions of surface conditions, ball-green or ball-hole physics for roll and capture over contoured surface, or the perceptual processes of how the individual golfer perceives slope and contour so as to effectively visualize and predict the

“A curious anomaly is found in a review of golf literature of the past fifty years. Ninety percent of the literature deals with moving the ball from tee to green. Although there are hundreds of books and articles published on putting they deal almost exclusively with grip, technique, and stroking the ball. Practically nothing is written on how to read the green and estimate or calculate how much a ball will break.” — H.A. Templeton, *Vector Putting* (1984), 7.

curving path of a breaking putt or makes use of these perceptions in selecting and executing line and pace for the putt that corresponds to the read.

Touch. Similarly, although “distance control” is widely recognized among the ranks of professional players as the most important skill for putting, golf teachers commonly profess that “touch cannot be taught.” Apart from the sole book by Bob Toski, *The Touch System for Golf* (1972), written over 35 years ago and limited to popular psychology notions that “touch” is an expression of “unconscious competence” as when a person signs his or her signature, no one in golf history has grappled with this essential aspect of human movement in a reasoned, sustained approach. The resulting lore of golf for distance control has long remained stagnant with a few simple drills for putting to the fringe of the green or putting a series of distances along with the ever-present notion of “lagging” long putts to a large target so that the ball ends up within about three feet of the hole and the annoying saying: “never up, never in.”

“Rhythm and timing are the two things which we all must have, yet no one knows how to teach either.” — Bobby Jones

“To be honest, I don’t think there is any way to tell somebody how to read greens. Reading greens is a learned ability.” — Kite, Tom & Dennis, Larry (1990). *How to Play Consistent Golf* (New York: Golf Digest/Tennis, 1990), 170.

The most widely accepted claim currently is that the “optimal go-by distance” for all putts is 17 inches past the hole, regardless of grass type, green speed, or putt length. (Pelz, 1983 & 1989). But the research data supposedly supporting this claim actually disproves it and establishes instead the common-sense understanding that the go-by speed for optimal sinks will vary based upon these same factors. (For Pelz’s actual data, see Dennis, Larry, Die putts at the hole — and you’re dead: New tests prove you’ll make more putts hitting them harder, *Golf Dig.*, 28(7), Jul 1977, 52-55.) On greens in the 1970s,

this variation data ranged from 5-10 inches past on good bent greens, 10-15 inches past on poor bent greens, 20-30 inches past for good Bermuda greens, to 30-40 inches past on poor Bermuda greens. The “best go-by” distances in this data for bent greens averaged 12.25”; for poa annua greens, 32”; for Bermuda greens, 27.5”. The Pelz 17” is not in this article, as he therein states explicitly that his data confirms that there is not one specific go-by distance that is best for different grasses and instead the optimal go-by distance will vary with the grass type and its condition. Indeed, 17” past is too fast for all bent greens and too slow for all poa and Bermuda greens Pelz studied. More to the point, greens since the 1980s have improved dramatically, so this 1976-77 data is stale and outdated, and scientific attempts to confirm or support Pelz’s claim that 17 inches is optimal have failed. (Werner & Grieg, 2000).

Perhaps more importantly, the real physics of ball-hole interaction that determines whether a rolling ball drops in and stays within a cup has been examined solely in obscure physics journals, and has played no role in informing golfers about how best to think about and learn effective pace on putts. (Holmes, 1991; Mahoney, 1982; Penner, 2002). The tired old debate of whether a golfer should “die his putts at the hole” or “putt aggressively” continues unmolested by informed science, as it has since the 19th century.

Putter Aim. About 90% of all golfers, including professional players, do not aim their putters inside the hole on a straight ten-foot putt, and also are not aware of this, instead believing wrongly that the putter face is accurately aimed to the center of the cup. And yet these golfers also mistakenly believe that when they succeed in rolling the ball straight on line into the cup, that they have done so with “a straight stroke” when obviously the stroke sent the ball somewhere other than where the putter face aimed at address. Only in recent years, using lasers, have golf instructors and players begun to realize that there is a problem, but still no one in golf history has made a

reasoned, sustained effort to understand how the golfer accurately perceives and aims his putter. Instead, the best advice current today is to use a laser training aid and “somehow get better aiming the putter face accurately through repeated trial and error.”

In the 1950-1970 era, pros heeded a simple two-part rule: 1. eyes directly over ball, and 2. back of head flat or level with the surface. This combination implicitly generates a straight-out gaze that aims the eyes the same direction the face is aimed. Pros after about 1980 seem to have lost this lore, using only the first part, and seeming unmindful of the second half of the “rule”, and in any event completely ignorant about the significance of the gaze direction of the eyes out of the face.

“A study of tour pros a few years ago showed that more than 75 percent of the 100 players tested aimed to the right to varying degree. I think the percentage is even higher among average golfers. A lot of it has to do with setup. Too many golfers look at the ball from an angle either “inside” or “outside” it. They lean too far forward and their eyes are beyond, or outside, the ball; when they look along the target line, they see an elliptical curve from left to right. If their eyes are inside the ball they see the curve from right to left. They adjust the clubface to what they are seeing and end up aiming incorrectly. That’s why your eyes must look straight down on the ball. When you look straight down you see only straight lines.”
 — Rodgers, Phil & Barkow, Al (1986). *Play Lower Handicap Golf* (South Norwalk, CT: Golf Digest, 1986), 91-92.

Notwithstanding the contributions of optometrists to golf, with suggestions about the clinical aspects of eyesight as applied to golf situations (Coffey, 1990 & 1994; Farnsworth, 1997; Gregg, 1972; Lampert, 1998; Kaluzne & Piparo, 1999; Runniger, 1971, 1977 & 1980; Tieg, 1983), the perceptual processes by which a person generates accurate information regarding putter face orientation and aim across a green has not heretofore been examined. The issue is not vision, but the role of visual

processes in spatial perception, for both line and distance. (e.g., Hoffman, 2000). Among teachers and players, the key issue for this skill is not well defined: How does a golfer standing beside the ball look down at the putter face as aimed and knowingly generate accurate perceptions to determine where in fact the putter face aims at some distance across the green?

Stroke. The clear bulk of all putting instruction concerns the stroke, in isolation from targeting for read or aim and from touch. And throughout the history of written golf instruction, the debate has always been whether the putting stroke is “a miniature golf swing” (e.g., Utley, 2006), or should be more deliberately controlled in a “straight back and straight through” pattern (e.g., Pelz, 1989). This debate rages today between advocates of the so-called “arcing” or “gating” stroke and those teaching a stroke whose path runs straight back and straight through. All golfers and all techniques are erroneously assumed to fall into one or the other of these “black and white” categories.

The truth appears to be, rather, that what really counts is a consistent, accurate stroke pattern that “rolls the ball exactly where the putter face aims at address.” This definition of what constitutes a “straight” stroke — one that rolls the ball the same line that the putter face aims down at address — is not in fact the implicit understanding of golfers generally, who instead think of a straight stroke as “one that rolls the ball at the target, regardless of the aim of the putter face.” Hence, the vast majority of golfers do not know where in fact they are aiming the putter face OR how they generate a stroke that rolls the ball at the intended target, and these golfers certainly do not possess a stroke that simply rolls the ball where the putter face aims at address.

From the perspective of the physics of the ball-putter interaction (and a bit of the ball-green physics as well) required for accomplishing a straight stroke, what really matters is a square

putter face moving straight on line at the onset of impact and remaining square and on line beyond impact for about 2-3 additional inches, without excessive launching of the ball off the ground or imparting too much backspin.

Closely examined for the dynamics of the stroke right through impact, the great flatstick artisans of history all accomplish this same simple dynamic, albeit on the surface their techniques appear wildly differing. Walter Travis' "open stance" putting stroke circa the 1910s, Walter Hagen's "hooding stroke" in the 1920s, Bobby Jones' "miniature golf swing" stroke in the 1930s, Horton Smith's "hooded stroke" in the 1940s, Bobby Locke's "hooking stroke" in the 1950s, Billy Casper's "wristy stroke" in the 1960s, Jackie Burke Jr.'s and Bob Charles' "shoulder stroke" in the 1950s and 1960s, Ben Crenshaw's supposed "naturally gating" stroke in the 1970s, Loren Roberts' "shoulder stroke" with subtle wrist action in the 1980s, and even Tiger Woods' "release stroke" in the 2000s *all* look extremely similar right through the critical impact area, where physics rules.

How this stroke dynamic is performed, or taught and learned as a skill, is hopelessly confused by "the smoke and heat without fire or light" generated by the stagnant debate on the "correct" path of the putter head moving back and through. When the issue is clearly defined and viewed from the perspective of the human body moving in the three dimensions of space and the dimension of time, and in light of the historical variations of technique for accomplishing this vital dynamic, the standard debate appears strictly two-dimensional and largely irrelevant to the skill.

The skill boils down to meeting the ball with a square putter face that remains moving on line throughout the contact with the ball. The purpose of the backstroke for straight strokes is to make this vital forward stroke thru impact as simple as possible and certainly not any more difficult or troublesome than

it need be; the purpose of the thru-stroke is to get the vital part during impact performed consistently, and the rest is window dressing that hardly matters. Nothing really requires that the backstroke be mirror symmetrical with the forward stroke, either in terms of path or size or movement pattern. Similarly, nothing requires that the putter remain on line beyond impact. The critical impact zone is all that matters for the physics. The human, however, may need to take into account motion positions and space beyond the narrow span of the impact zone. But fundamentally, the more closely one focuses upon what happens in the impact zone for different great putters in different eras using different styles and techniques, the more these golfers share the one true fundamental thru impact.

As Paul Runyan said, "Putting requires a deep understanding of delivering the putter squarely thru the ball."

A NEW PARADIGM.

This being the historical and current state of golf lore for putting, with three skills largely unexplored and the one skill of the stroke mired in deep confusion, the serious golfer will perforce seek common-sense guidance about these issues from somewhere other than conventional golf teaching. Where, exactly, should one look for help to sort these skills out? This book is my effort in that direction.

Over the past two decades, my researches necessarily have taken me beyond golf teachings to a study of how the human perceives and moves in successfully performing the fundamental skills of putting. The focus on perception and movement means one must study the human body and how a person's brain and body function with these processes in the competent, skilled performance of putting tasks — to wit, human anatomy, biomechanics and kinesthetics, motor skills teaching and learning, and above all the neuroscience of human perception and movement. The new paradigm for putting performance focuses not upon "how the putter moves" in the robot-

ics or engineering sense of the past three decades but more essentially and comprehensively upon how the human actor perceives and moves in putting. The issues then become how the golfer on the green perceives the anticipated successful putt in order to select a target, aims the putter face at the target and is able to perceive this aim accurately, and then makes a stroke motion based upon these perceptions that rolls the ball the same line the putter face aims along with the appropriate touch or energy or pace so that the ball follows the anticipated path of the “read” and drops deep into the cup and stays there.

Fortunately, the neuroscience of human action for perception and movement, as with all neuroscience, has in the past 10-15 years surpassed and supplanted all prior knowledge about the brain by many times over. The dramatic explosion in new knowledge from the neurosciences since 1990 has revamped not only the medical, psychological and psychiatric fields, but has made available numerous insights and approaches applicable to all aspects of human behavior, including skilled movement performance and motor learning. Distilling this fresh science for perceptual and movement processes and reformulating it into simple golf instruction for the four skills of putting is the work of the current new paradigm.

WHERE IS THIS HEADED?

The main thrust of this new approach is to complement and enhance innate human processes for perception and movement in putting. That is, the golfer wants to learn how to putt instinctively using the same processes of perception and movement relied upon by all humans every day since the beginning of human life. And moreover, the golfer needs as well a simple understanding of “what works and why” for instinctive putting, so that instinctive putting becomes mindfully consistent without streakiness, so that putting experience over time is not wasted but is filtered accurately as meaningful feedback for what works and why, and so the golfer is empowered to self-coach during every round of golf and is able to fix flaws

and return to “what is known to work and why” for consistent excellence without struggling the rest of the round.

I term this enterprise “*The Mechanics of Instinct*”, meaning not that golfers require a full-blown education in neuroscience, but that golfers need to know in simple terms how to use their innate processes accurately and effectively on the green.

What one comes to appreciate from this new approach is that every single putt is the same — the same process of selecting a target, the same aiming and setup process, and the same stroke with the same tempo. The only thing that ever differs is target and the length of the backstroke, and as you’ll see even the backstroke is not something you have to think about at all if you have good tempo and a rich targeting process. In other words, the golfer on the green will always do exactly the same targeting and aiming / setup routine, and will always make exactly the same stroke movement and always putt the ball in exactly the same way. The ball will always roll away from the putter face and setup in exactly the same direction. There is not much to think about, at least once the target is selected, other than do the same steps of the process well and consistently the same every time.

Optimal putting is simple, natural, instinctive — even “minimalist” — and above all conforms to the realities of physics and the situation “as it actually is” and not as one might hope or suppose it to be. The instincts are born out of the daily interchange with reality, since failure of this adaptive process means death and extinction. The usual instincts for movement are therefore gracefully useful for putting skills.

When the golfer knows how instinctive putting actually works in the brain and the body, he or she knows in an optimal way “what works and why” for great putting. This in turn gives the golfer true competence, and competence makes its own confidence. Under pressure, the golfer simply relies on “what

works” and goes about the job of performing in the usual manner, secure in the belief that only this approach gives the best chance of successful putting. The anxieties and doubts that cause others to revert to some earlier poor habits do not plague the golfer who knows “what works and why” in his approach to putting.

“Competence breeds confidence.” — Jane Crafter (Crafter, 1997).

“Putting competence is a mastery of physical ability to sink a putt or lag a fifty-foot putt close for a “gimme.” Putting competence also includes the ability to aim the putter face correctly and stroke the ball solidly on your intended line. Psychological putting competence includes the ability to read greens, judge breaks, have a feel for distance and speed, and creatively visualize the entire process. These components of putting competence are vital for developing confidence in your putting. In golf, confidence and competence may be inseparable, but competence is the foundation for confidence. ... The putter is not magic. Real magic happens when your hand-eye coordination, attitude, confidence and competence are working toward the same goal: to make a putt.” — Patrick Cohn & Robert Winters (Cohn & Winters, 1995).

The skills described in this book are based upon the realities of physics governing the green and human motion on earth, the neuroscience of action for perception and movement strictly focusing upon putting skills and tasks adaptive to reality, and the best of golf lore for how to putt from the history of the game. The intention is to understand and teach these skills with a view towards optimal human performance during putting in a form readily profitable to novices, avid amateurs, and top-level professionals alike. (For more, see my *The “Mechanics of Instinct”* in *Putting: The Neurophysiological Paradigm for Applied Research*, PuttingZone.com, <http://puttingzone.com/Science/Mechanics.html>.)

OPTIMAL PUTTING: BLACK ART OR SCIENCE OR BOTH.

The classic debate among golfers is typically framed in terms of whether putting is an art or a science, whether the golfer is an “artist” or a “mechanic.” (E.g., Achenbach, 1985; Golf Magazine, 1973; Golf World, 1953; Palmer & Dobereiner, 1986). The terms of this debate have continuously influenced teachers and ideas about teaching and learning putting.

The dominant strain of conventional lore has been that putting is an individual art that cannot be taught. This attitude, expressed directly by five-time Open Champion J.H. Taylor, underlies the paucity of teaching putting: “After a fair amount of proficiency has been acquired in the use of the cleek, iron and mashie, we have the difficulty of putting to surmount. And here I may say at once it is an absolute impossibility to teach a man how to putt.” (Palmer & Dobereiner, 1986, 134). A related attitude is that one should not make the attempt, as this merely complicates a simple, natural motion: “Muscular movement takes place in every move we make but no golfer needs to read a thesis on lachrymal ducts in order to cry after a bad round. ... Walk up to the ball with your putter and stroke it (the ball) toward the cup. This is the kind of instruction we can follow and it works rather frequently.” (Golf World, 1953, 16). A third aspect of this same complex of attitudes is that “feel” cannot be taught or learned except by lengthy experience, as stated by George Archer: “Only after you hit thousands and thousands of putts will you begin to develop feel.” (Golf Magazine Nov. 1981, 80). Golfers in this camp invariably describes themselves as “flatstick artists” relying principally if not exclusively upon “feel” day in and day out for putting success.

The problem with so-called “feel” is that it is a variable, evanescent, and changeable subjective state of the mind, and not closely correlated with objective reality in a fundamental way. This extremely vague (if not completely vacuous) term “feel” is perhaps responsible for retarding the learning of putting more

than any other naive notion afoot in conventional golf lore. Aside from lacking definition, reliance upon “feel” leads inevitably to streakiness. Jack Nicklaus: “The test of a golfer is over a period of time, and the ones who succeed are those who work on fundamentals. When a guy plays well one week and doesn’t do it the rest of the year, he’s trying to rely on feel and rhythm rather than the fundamentals.” (Achenbach, 1985, 78).

In conventional lore, “feel” and “artistry” are in contrast to “mechanics” and “fundamentals”, as if the two are mutually exclusive. In truth, no great art emerges without first being preceded by long study of fundamentals. Putting is like a solo performing art and the consistent quality of performance arises from years of study and practicing fundamentals. Picasso trained in his early years to learn the techniques of the Old Masters before he developed his own unique style and approach. Phil Lesh of the Grateful Dead is a classically-trained musician, applying Bach counterpoint to his rock rather than the standard soul or rhythm and blues patterns. (“Many people out there know that I was trained in classical music, and I studied composition for many years before joining the band.” — Phil Lesh.) Moreover, only after the fundamentals are mastered may an artist then give full expression to his personal creativity. All else is “naive art.”

Art and science in putting, then, are combined. The specific way in which fundamentals underlie the creativity has partly to do with the common neurophysiology of normal adult humans and partly to do with the sequencing of perceptions into movement as part of a unified “action.”

Normal adult humans all share a very wide and deep common legacy of perceptual and movement processes in the brain and body. To the extent all unimpaired humans have two legs, two arms, two hands, similar musculoskeletal form, one putter, and one ball, then facing the same putt on the same green has much more in common for all golfers and much less of

a unique and idiosyncratic character than is commonly accepted. It's all well and good to focus upon the finer nuances that separate one golfer from others, but these "signature" characteristics in putting should not obscure the more important perspective that the largest proportion by far in the common versus unique mixture resides in the commonality of the perceptual processes and the movement processes engaged by all adults when putting.

To the extent a golfer values and cultivates the idiosyncratic over the fundamental, he or she relies in an unmindful way upon the perceptual and movement biases that have crept into his or her life over the decades. An office worker compared to a farmer or forest ranger or a professional soccer player each experience the world from a different "façon de voir", with different postural, visual, and movement characteristics. The whole point of training in fundamentals, however, is to overcome the influence of these covert biases for the sake of intelligent choices and control. Because these biases are unmindful and thus elusive, the golfer dependent upon them has no certainty that his or her putting will be "on" in a given round. K.J. Choi won the Greensboro Championship in 2005 with excellent putting and was asked what was different: he replied that he had somehow remembered something about how he felt when he putted very well five years earlier.

And this brings us to the sequencing. Learning fundamentals and expressing artistry in putting are not incompatible except to the extent the golfer remains in the "naive" realm, unmindful of how the brain and body work and hence heedless of or lacking significant influence over the biases brought like so much baggage to the game of golf. Putting mastery on a consistent and optimal basis cannot be attained without first mastering the fundamentals that face all golfers in common, and mastering these fundamentals does not necessarily imply "paralysis by analysis" when putting. The whole thrust of the "Mechanics of Instincts" approach is to harness knowledge,

thinking, planning, and analysis in the service of innate, instinctive processes of the brain and body during the “action” of putting. This integrating of the conscious and the unconscious (or, more properly, the non-conscious), requires explicit working knowledge of the skills and tasks in putting and the correlated perceptual and movement processes of the brain and body for consistent excellence in executing those skills and tasks. With this foundation, good “feel” can then be learned in the proper cognitive context for “what works and why”.

This working knowledge, then, on the course, expresses itself as focus upon “relevant cues” for what works best and for the marshalling of conscious and non-conscious processes in their appropriate ordering. At the end of the day, a masterful putter knows what works and why it works that way so the focus stays upon relevant performance cues when staging perception into movement, or staging conscious and non-conscious information gathering about the world in order to formulate and predict the optimal motion for execution in a predominantly non-conscious, or instinctive, manner.

This statement by Dave Stockton, Jr., illustrates the staging process and how executing the stroke itself proceeds from non-conscious processes:

“When you get into position to stroke the ball, there should be no thoughts at all regarding the mechanics of putting — grip, stance, length of stroke, etc. You are now in the realm of intuition and feel. ... Feel for putting is not a conscious effort, which produces tension, but more often is the result of an indirect, in a way offhand, approach. ... Mechanics vary from day to day simply because we don’t always feel the same; our adrenaline flow and metabolic rate vary; some days our hands feel fatter than on other days. It does little good to force an address position or a stroke pattern onto a body that

simply does not want to do it that way. Room must be left for physical and psychological divergence in our makeup and for intuition and instincts of the moment to play a role in performance. That implies trusting your instincts and intuition. Odd though it may sound in a world that is becoming increasingly more “programmed,” I have found that trusting instinct and intuition is more reliable than a robotic adherence to a fixed, immutable set of physical mechanics. The best golf is played by people with imagination; who have a willingness to improvise, to fit their action to the moment at hand and how they feel at that moment.”

(Stockton & Barkow, 1996, at 22, 29, 33-34.) Stockton’s view blends “feel” and “mechanics” in the context of this staging with the emphasis upon “feel” at the expense of “mechanics” in the execution of the stroke itself. The sense of “mechanics” in the present book, however, is two-fold: the “mechanics” of the innate, instinctive processes that integrate perception and movement, and the “mechanics” of form and motion in executing the stroke.

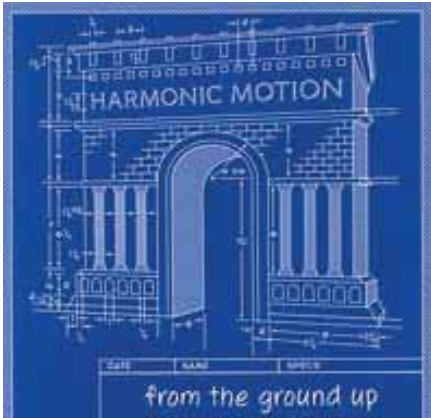
Thus, many golfers emphasize “feel” at the expense of “mechanics” while equally as many emphasize “mechanics” over “feel”. The “Mechanics of Instincts” approach, however, seeks the proper balancing of the two by teaching how mechanics in the first sense underlie and inform “feel” in the planning and aiming stages of the action while a mindful know-how about instinctive “feel” admits a role for mechanics in the second sense to bring consistency and to banish streakiness in executing the stroke movement for even the best flatstick artisans of the day. The proper sequencing of this knowledge means that the master putter does not think, but instead has deep know-how about how to see and perceive the requirements of the putt in such a way that these relevant cues feed into the same-every-time technique for the stroke that proceeds almost

entirely from the non-conscious realm. The know-how boils down to “look and putt”, with “feel” knowledge embodied in the golfer’s body like air in the sky. (Gibbs, 2005).

In the final analysis, instinctive action is simply normal action — the daily act of opening a door or picking up a glass of water from a nearby table. (Jeannerod, 1997). These actions depend upon know-how for attending to the relevant cues in an efficient, simple manner, and upon common movement patterns for carrying out the task. The “Mechanics of Instincts” teaches how to use “daily instincts” for optimal putting skills.

There is nothing else to learn, fundamentally, although there are many, many nice elaborations of these four skills. Learning the psychology of putting is something tackled only in light of the development and nurturing of these four skills, as your skill level determines what sort of psychological issues you will need to deal with.

The relationship among these four skills is important to appreciate. As discussed more fully below, Distance control relies upon Tempo and Targeting; the Stroke for accuracy and consistency also relies upon Tempo and the timing of the motion dynamics; and Reading putts depends upon Touch. For this reason, Tempo actually directly underlies three of the four skills (all but Aiming the putter). More broadly speaking, neuroscience teaches that perceptual processes are not distinct from movement processes but are integrated phases of a unified “action.” Hence, Reading putts and Aiming the putter (perceptual processes) together with the perceptual processes from planning Distance control and Stroke movement all guide and inform the execution of the movement for a stroke that rolls the ball straight at an effective target with good touch. For this reason, there is a heavy emphasis at the outset on Tempo and Touch.



LEARN THE SKILLS FROM THE GROUND UP.

The above four fundamentals are ordered chronologically, but in fact it is better to learn them in the order 4, 3, 2, 1 — sort of like a sock turned inside-out. So, I recommend learning first a solid, repeating, excellent tempo as the

basis for distance control. Then one should learn how to putt straight, no matter where the face is aiming thru the ball, by using consistent movement biomechanics. Next learn to putt straight at a specific target by correctly aiming the face and then setting up the body to the aimed face. Finally, using the ability to putt with known distance control and known straight putting accurately at any target, learn how to read a putt for purposes of selecting a target to aim at and start the putt off straight out of the setup with good touch. [Readers not so interested in the theory might wish to skip ahead to the application (chapter 4), for specific advice about how to putt with instinctive touch.]

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Chapter 2:

The Brain and Movement in Space

WHY LEARN ABOUT THE BRAIN.

The reader may well ask: Why would I need to know any of this about the brain? The response is: In order to understand how to putt. Perhaps the reader then asks: Why do I need to “know” how to putt? Can’t I simply putt well without knowing all this detail? The response is in two parts: First, every golfer needs to have “some basic understanding” of HOW putting works at an optimal level and WHY things are that way. Without this basic understanding in mind of the HOW and the WHY of excellent putting, the golfer is left adrift on the flotsam of evanescent and unreliable memory of subjective feelings, and this is a certain recipe for streaky putting. Second, the golfer needs to attain a personal comfort level in believing the HOW and WHY and different golfers require different degrees of detail to attain this comfort level. Perhaps the reader asks: But won’t this “knowledge” hurt instinctive putting, the same way the centipede who tried to “think about walking” fell down in paralysis by analysis? The response is: The HOW and WHY of INSTINCTIVE putting teaches the golfer HOW NOT to think, WHY NOT to think, and HOW and WHY to use the non-conscious INSTINCTS instead.

“To begin at the bottom then, if the physiologists are not all wrong, to excel in golf requires first of all a good brain.”
— Arnold Haultain (Haultain, 1908, 70).

Finally, the reader may ask: Why is Instinctive Putting “optimal” as opposed to putting according to conscious techniques as usually taught? The response is: Conscious techniques use inappropriate processes of the brain for perception-movement action, and using these processes instead of the Instinctive

and non-conscious processes both causes harm and depletes available resources needed for effective action. The conscious brain does little to facilitate perception (apart from mindfulness or attentiveness) and has even less to do with effective movement, especially those sorts of movements that have been so successfully adapted to gravity and the earth environment in the non-conscious processes.



The expression “imagine how good we could be if we used more than 10% of our brains” is exactly backwards for putting action. Putting skills require “competence”, and the sort of competence that admits of consistently excellent putting over weeks and years, without the

steakiness that besets the putting of even the best players in professional golf (e.g., Tiger Woods, Phil Mickelson) implies a deep knowledge of “what works and why”. No golfer without this hard-earned “know-how” is able to self-coach during a round to eliminate putting woes and get back on track. The usual approach of today’s pros is to concentrate on ballstriking skills and know-how while merely “hoping” that the putting is there when needed. A “smart putting brain” does not develop merely by repetition, as this leaves out the cognitive “know how”; a “smart brain” that trains performance according to trusted know-how for “what works and why” is not using the unhelpful brain processes and instead is engaging only the directly relevant brain processes for the task and skill at hand. For putting, “less is better”, but the correct less at the right time is best. (Gladwell, 2007; Hostetler, 1998). The golfer needs at least a rudimentary top-down knowledge of brain processes and functions in order to guide the learning process along the right pathways.

Moreover, there is a consistency in the non-conscious action processes of the brain as movement is planned and executed in tune with gravity as usual that is not readily or commonly available to golfers using conscious techniques, especially for timing and force aspects. In other words, instinctive putting has a sameness about it that makes putting as consistently successful for its action as the action of opening a door or taking a glass of water up from a nearby table. And finally, instinctive putting is minimalist in terms of what the golfer needs to do after the perceptual aiming process: the golfer putting instinctively needs to make a backstroke that joins in with the usual timing of gravity or with his usual timing other than gravity. This alone, in the final analysis, is the keystone of instinctive putting on a consistent and accurate basis.

Optimal putting is the most potent and efficient use of accurate perceptions for generating effective stroke movement that is also simple, accurate and consistent in terms of line and distance, as well as variable and applicable to a myriad of different putts under differing environmental, playing, physical, psychological and equipment conditions. Instinctive action produces optimal putting better than any other approach.

RAISON D'ÊTRE FOR BRAINS.

There are two life forms: plants and animals. The basic difference is that plants do not move and animals move. This gives animals a survival advantage in that animals are able to seek out a variety of food sources and habitats and niches, whereas plants must accept what

"I believe that the nervous system evolved to enable movement. Plants are living proof that you don't need a nervous system when you live rooted to the ground. I also think that viewing the neural mechanisms creating movement and sensation as independent brain activities misses the point. Sensory and motor systems continuously interact to allow movement. The sensory system provides goals for and regulates the generation of each movement." — Craig Evinger, SUNY Stonybrook Neurobiology, http://www.hsc.stonybrook.edu/som/neurobiology/evinger_c.cfm.

fate deals them for location and food.

Animals have brains whereas plants do not, and the principal if not the only reason animals have brains is so that they can move on earth successfully, without injury, waste, or excessive vulnerability to attack. The brain makes movement possible by integrating spatial perception of the animal and its positional situation in the local landscape with the mechanisms of movement in the biomechanics and physiological design of the animal's body to allow successful "action" in the environment.

In other words, the brain "predicts" the consequences of "action" in the environment. This ever-repeating cycle of prediction followed by experience followed by comparison of experience to initial prediction teaches the animal more and more about the environment and perception-movement in the environment. The animal becomes "tuned" to "the world as it is" by ongoing experience. (Berthoz, 2000; Llinas, 2001).

HUMAN BRAINS AND MOVEMENT INHERITANCE.

In the evolutionary history of animal life on earth, the human species is a recent arrival on the scene. The human species first emerged roughly 1.8 million years ago, in the context of the beginning of life on earth around 3,500 million years ago. If the whole of life on earth (3.5 billion years) occurred in one day with 24 hours and a total of 1,440 minutes, humans have been on the planet no more than about 3/4th of one minute (45 seconds out of a day). Expressing the same in terms of a one-kilometer journey of life over 3.5 billion years, the human species has traveled a mere 1/2 meter of that journey.

The pattern of animal evolution has been that higher forms of life inherit successful adaptations and add to or modify these preexisting patterns, rather than abandoning success and starting fresh. (Eccles, 1989; McLean, 1990). The one process that ALL land animals have faced in common is movement in the

same gravity, where all movements are influenced in terms of force and timing. Hence, every animal species that survives on earth has adapted to gravity successfully. It is not surprising, then, that animals share a common brain structure for timing and moving in gravity, or that this successful adaptation has been incorporated in the evolution of higher forms of life without radical alteration.

In humans, the cerebellum (the “little brain” at the back of the brain stem) carries forward the animal timing and movement processes from earlier animal species. The cerebellum is a vast interleaving of single Purkinje cells (like flat trees stacked as a deck of cards sideways along the sidewalk by a street) that receive via one “climbing fiber” for each Purkinje cell nerve signals from and that coordinate vision, balance / equilibrium, and the body-in-space. This input is then transformed by a string of “parallel fibers” running through the branches of the Purkinje cells (like telephone wires aligned with the street, up to 200,000 parallel cells connecting to each Purkinje cell) into nerve signals that coordinate the smoothness and timing of body action in space with respect to the environment. The cerebellum thus extracts real-world timing from the body moving in the environment, and experience “tunes” the brain to reality at the level of the instincts.

Of all human brain structures and functions, the cerebellum is the least changed from its expression in earlier vertebrate life forms. The brain of a mole and a rodent and indeed of birds and fish all share a very similar structure in form and function to the human cerebellum. The reason for the similarity is that all animals need the same basic timing information about the body moving in gravity. (E.g., Bell, 2002).

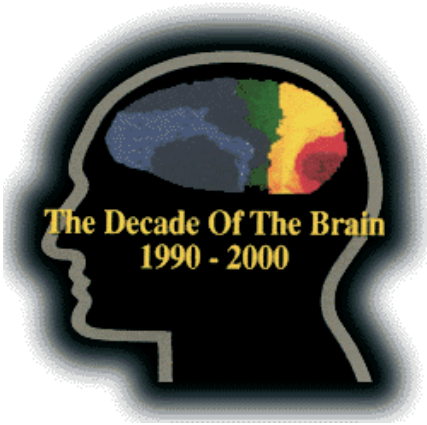
The evolutionary development of the human cerebellum over the past 1.8 million years has seen a shift of consciously applied rules for repeated action from the cortex (neocortex) to the non-conscious processes of the cerebellum for stereotyped

patterns of action, thus allowing greater neocortex capacity for more advanced conscious operations and for uniquely conscious processes like language and symbolic cognition. One researcher explains the shift in these terms:

This complementary cognitive interaction of the cerebellum and neocortex has been modeled as a dichotomy between explicit (declarative) and implicit (procedural) cognitive processes. The neocortex plays a role in both explicit and implicit learning, but explicit learning invokes more intense neocortical activity. Explicit learning results in “knowing that,” as opposed to “knowing how,” and facilitates the manipulation of data to provide unique, flexible solutions in unforeseen situations. On the other hand, although the cerebellum may be invoked for explicit tasks, e.g., word searches or stem completions, its primary processing mode appears to be implicit, algorithmic, and rule-based, resulting in “know-how.”

(Weaver, 2005). The quarry for optimal putting is not “knowing what” but “know-how” in the dual sense of embodying “what works and why” in the form of everyday instincts for action.





BIG IDEAS FOR BRAIN FUNCTION.

As the examination of the action in putting goes forward in this book, different perceptual and movement process will fall beneath the spotlight for closer study. At the beginning, a little groundwork about the brain in general is in order.

The 1990s were designated by the US Congress as “the Decade of the Brain” in recognition of the tremendous strides achieved in neuroscience in recent years. While clearly a great deal remains unknown and even unexplored about the functioning of the human brain, the years since 1980 have witnessed an explosion in our knowledge about the organization and processes of the brain. This great expansion of knowledge has taken place mainly at the neurophysiological level, relating neural processes to physiological processes. Out of this body of research has emerged a consensus view of the brain that is represented in the following “big ideas”:

1. **Human brains are a result of primate evolutionary developments.** Human brains are a result of primate evolutionary developments and retain primitive components and functions overlaid with more recent and sophisticated structures and processes (Eccles, 1989; MacLean, 1990). The homo sapiens brain is a descendant of its evolutionary predecessors. In general, animal brains have advanced by modification of preceding structures and processes rather than by abandonment or wholesale replacement. As a result, the human brain can be considered a layered organ, with older, more primitive structures and functions overlaid with more adaptive and complex features (the so-called “Triune Brain”).

As advanced biological adaptations freed up primitive capacities and made possible a higher brain-mass ratio, some specialized structural features of the human brain became possible, such as language and symbolic reasoning. The human brain, then, is a composite of primitive and advanced components, with some overlapping of function. In particular, the human emotional system retains many features in common with animals, albeit subject to the restraints of self and society via the inhibitory controls of the frontal lobe. In addition, certain features of the human visual system, such as motion detection of threat or prey, coexist to complement more advanced visual processing. Because of this evolutionary relatedness of the human and other animal brains, the experimental study of animals (especially rats, cats, and monkeys) frequently supplies the bedrock knowledge about brain function that must be interpreted and applied to the human brain by taking into account known structural and processing differences.

2. **Brain function depends upon synaptic signaling via neurotransmitter and neuroendocrine chemistry.** Brain function depends upon synaptic signaling via neurotransmitter and neuroendocrine chemistry, and hence upon neural pathways, connections, and interactions (Kandel, Schwartz and Jessell, 2000; Shepherd, 1990). The central nervous system, including the brain and spinal cord, is essentially a complex network of interconnected neurons that process sensory input and output physical or cognitive behavior. Environmental inputs are electromagnetic radiation, chemical, sound waves, and mechanical contact. These sources of information about the world are converted by our sensory organs into electrical signals that course along each neuron. But between neurons, at the inter-neuron junction, there is a minute gap, and transmission of the signal across this gap is accomplished by release of neurotransmitter or neuropeptide molecules that diffuse across the gap to be received by receptor molecules specifically structured to capture and react with a given transmitter. The nature

of this neurotransmitter process, combined with the structural typology of the neural cells and circuits, determines the sort of processing the environmental signals receive inside the brain. Some transmitter molecules are “excitatory” and tend to elicit an electrical firing of the receptor neuron, thus passing the signal along in the circuit. Other neurotransmitters, however, are “inhibitory” and tend to suppress the firing of the receptor neuron. Much of modern neuroscience is concerned with the detailed mapping of the connections in the human brain and with the functioning of the neurotransmitter system. For this purpose, anatomical studies post-mortem provide the most direct evidence of connecting patterns. Certain techniques for tracing neuronal pathways in vivo and neuropharmacological studies are also relied upon.

3. **Brain activity requires the metabolism of glucose from the blood supply.** Glucose in the blood supplies the metabolic energy for brain functioning. The human brain consumes approximately 20% of the glucose in the blood stream, even though it typically constitutes no more than about one-fiftieth of the body mass (ten times more than proportionate to mass). This glucose metabolism and the related blood flow to active brain sites can be monitored by neuro-imaging techniques to yield functional data about brain processes with good temporal and spatial resolution (e.g., Positron Emission Tomography, or PET scans). (Andreassi, 2000; Kandel, Schwartz and Jessell, 2000).

4. **Brain development proceeds in stages of proliferation and pruning, resulting in considerable individual variation in capacities and preferred modes.** Brain development proceeds in stages of proliferation and pruning during early childhood and continuing through adolescence, resulting in considerable individual variation in capacities and preferred modes (Edelman, 1988; Thompson, 1993). Embryonic and peri-natal development of brain tissue and structures proceeds at a phenomenal rate. Shortly around birth, the total neuronal population is largely established and in place, but the ensuing years of

childhood define the patterns of connections of inchoate brain modules. These early years of development are characterized by a proliferation of neural connections as the brain learns about and adapts to its environment. Eye teaming and binocular vision, language comprehension and expression, and walking, for example, develop only after birth. At the conclusion of early childhood, this proliferation is “pruned” to eliminate those connections and circuits that have not been favored by adaptive use. In a sense, each individual anatomically-normal brain “develops” after birth not unlike the photochemical process in photography, whereby light photons of different colors and intensities falling upon the light-reactive chemical of the film results in the image. During the years of puberty, a secondary although muted proliferation-pruning cycle occurs, and the adult brain is typically not fully clear of these systemic changes until somewhere between 18 and 21 years.

5. **The brain is plastic and its structures adapt to injury and as a result of learning.** The brain is “plastic” and its structures capable of adapting to injury and as a result of learning (Gollin, 1981; Greenough and Juraska, 1986; Held, 1965). “Plasticity” refers to the capacity of the neural structures of the brain to adapt to environmental stimuli, aging process, and insults. Whether the human brain can “regenerate” neurons in adult life stages is a matter of current study, but it is clear that the brain has the capacity to adapt to functional deficits and to rearrange its patterns of connections to generate alternative pathways and to accommodate newly learned patterns. For example, the cortical structures that represents finger sensation are normally distinct for each finger, but after amputation of a finger, this structural circuitry can become reorganized such that adjacent fingers encroach upon the absent finger’s neural territory. Similarly, in some cases of stroke in which vascular accident inside the brain destroys neural circuitry in a localized region, the individual can sometimes generate new pathways to restore function either partially or totally. And learning, defined as the establishment of long-lasting neural

pathways associating stimuli and responses (so-called Hebbian learning, from Hebb, 1949), is a form of plasticity. The amount of time to lay down these long-lasting patterns, or to modify or extinguish existing patterns, depends upon the conditions of learning such as motivation, rewards, practice regime, and similar factors.

6. **The brain processes information both serially and in parallel.** Serial (or one-thing-at-a-time) processing is the characteristic mode for thinking or internal self-talk and other cognitive functions, but other processes are carried out in parallel (many-parts-of-a-whole-in-many-locations). Many aspects of visual cognition are carried out in parallel. Those activities that are serial in nature typically have limited “workspace” or mental resources available. Consequently, attempting to carry out multiple tasks simultaneously can often outstrip available resources and lead to degradation of function. This is especially the case with visual attention. (Gazzaniga and LeDoux, 1978; Shepherd, 1990).

7. **The brain has specific modules and structures for specific functions.** In over 90% of humans, the language functions of hearing or reading and comprehending language and generating spoken or written words and sentences is localized in the temporal lobe of the left hemisphere. In the broader sense, logic, analysis, and symbolic thought are localized in this so-called “dominant” hemisphere. Strokes with brain damage confined to the right hemisphere seldom affect language functions per se. Naturally, auditory processing is close to verbal centers of the brain. But the so-called “non-dominant” hemisphere contains specialized centers for spatial awareness, musical and intonational appreciation, and more global intuitive processes. Visual processes begin in the retinas and proceed through the optic nerve to the thalamus inside the brain (lateral geniculate nucleus, LGN, and superior colliculus, SC), and then to the occipital lobe at the back of the head to the primary visual area (PVA, V1, or V17) — also called the striate

cortex. The striate cortex carries out analysis of fundamental visual features like edges, corners, colors, contrast, and intensities. From here, visual signals are passed to the extra-striate cortical areas, V18 and V19, where the features are seen as forms in relation. Tertiary processing then proceeds into the multimodal association areas, where forms are recognized as familiar objects and given contextual meaning and value. Body knowledge, or the sense of position and state of body parts in relation, general orientation in the external environment, and balance, is principally the function of the parietal lobe and its somatosensory cortex. Proprioceptive receptors in the skin, muscles, and joints signal this part of the brain about the state of the body in space, either statically or dynamically. In addition, vestibular sensory organs in the inner ear (semicircular canals and uticles) signal the state of orientation in gravity and accelerated motion changes of position of the head in space. (Gazzaniga and LeDoux, 1978; Kandel, Schwartz and Jessell, 2000; Ornstein, 1997).

8. **The brain has specific modules and structures for specific functions (audition, vision, language, movement, and so on), and certain functional processes and modes are dominated by structures in one or the other hemisphere, but behavior expresses inter-hemispheric integration.** The human brain has developed specializations beyond the other primates, especially language. Most humans have language functions concentrated in the left hemisphere, and the areas of brain devoted to language have forced other functions to pool in the opposite hemisphere. This is especially the case with movement and spatial awareness. The hemispheres are connected by “bridges” of nerve cabling that connect cooperative modules of the brain in opposite hemispheres and that otherwise coordinate total brain functioning. During the 1970s and 1980s, it was very trendy to speak about the capacities of the hemispheres as if they acted with complete independence, but in fact the normal adult brain is always a matter of both hemispheres

contributing to interaction with the world. Even so, localized specialization of function has important consequences for optimizing sports performance. (Gazzaniga and LeDoux, 1978; Kandel, Schwartz and Jessell, 2000; Ornstein, 1997).

9. **Motor movement in voluntary goal-directed action expresses the integration of sensory, cognitive, and emotional processes in the context of habituated patterns of movement.** The basic unit of brain function is action. The human brain, and indeed the brain of all animals, is the controlling organ by which the actor interacts with the world, by perception of threat or opportunity for survival and the adaptive behaviors available in response. Thinking, vision, body sense, and emotion should be the mere handmaidens of action. And action is movement. Golf putting, then, is primarily action in the context of the human repertoire of movements. (Jeannerod, 1997; Latash, 1998; Leonard, 1998).

10. **Identification and understanding of brain processes relies upon a complementary consort of investigative techniques, including neuro-imaging (EEG, PET, fMRI, MEG), lesion studies, animal experiments, anatomical and histological studies, and other approaches.** The normal adult brain contains over 100 Billion nerve cells, each with an average of 1,000 connections to other cells. The possible brain pathways is far more numerable in a single brain than all the atoms in the universe. The history of studying the brain makes it abundantly clear that modern science has only begun to learn the complexity of the brain. This history shows that neuroscientists must rely upon a wide array of techniques and strategies in order to tease out these subtle complexities and to gain an accurate overall understanding of processes and relations between processes. No one technique or approach is adequate alone, and can only add to our understanding when its unique contribution of data is interpreted against a background of data from other sources. (Frith and Friston, 1997; Kolb and Wishaw, 1985).

Throughout this work, these basic big ideas of the functioning of the brain are applied to the specific skills and tasks of reading putts, aiming the putter, stroking the ball where aimed, and controlling the distance, in an integrated and instinctive system of putting. As will become clear, “action” is not neatly subdivided in time into focus, perception, memory and association, planning, aiming, “feel” for distance, and stroke movement. Instead, “action” is a seamless sequence of interrelating brain processes that are layered, overlapping, redundant, persisting, resonant, recurrent, rhythmical — much more like a symphony of strings, percussion, woodwinds, brass. And like a well-trained and unified symphony orchestra, the golfer as conductor is required to know how each instrument is tuned and plays its scales at a rudimentary, mechanical level, before the expressive artistry can emerge in the performance of a specific masterwork of composition like a Bach fugue or a violin quartet by Beethoven. Putting is both science and artistry, and that makes it a craft on a level with the performing arts such as those practiced by musicians, painters, and dancers.

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Chapter 3: Distance Control Theory

SKILL 1: INSTINCTIVE TOUCH.

DEFINITION OF TOUCH OR DISTANCE CONTROL.

“Touch” is the ability to STOP a ball at a predetermined distance or location on a green with accuracy and consistency. Distance control always implies a final resting destination, as opposed to a location thru which the ball transits. With reference to a hole or cup in the green, however, distance control means the terminal delivery speed with which the ball crosses over the front lip, chosen to balance the need to get the ball over the surface irregularities and friction all the way to the hole with the need to have as much effective width of the hole available for ball capture as possible and the need to minimize comeback length in the event the ball misses the hole.

OPTIMAL DELIVERY SPEED.

The golfer must adapt to reality. Instinctive putting is based upon the brain’s interaction with the world as it is, whatever it is, without mediation by abstraction. Over time, the instincts are trained to the reality of ball-hole interaction according to the universal laws of physics. An examination of the relevant physics reveals that “touch” is a matter of objective reality, and not a question of artistic expression according to the unique proclivities of a specific golfer.

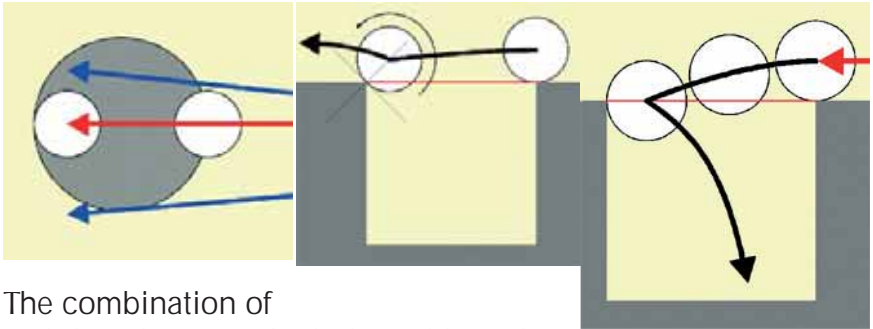
The physics of the ball-hole interaction is pretty straight-forward and informative about the optimal ball delivery speed but is also almost completely unfamiliar in the culture of golf. (Holmes, 1991; Mahoney, 1982; Penner, 2002). In order for a ball to transit the air of the hole, strike the back wall of the hole, and remain inside the hole, the ball while airborne must

drop in gravity at least half of its diameter. Otherwise the lower half of the ball will strike the upper rim of the hole while presenting the wedge-shape of the lower half of the ball, and the ball will rim out, lip out, or bounce out of the hole. Provided the ball drops at least half of its diameter before meeting the back wall of the cup, the ball's equator will meet the wall flush or at a point on the upper half of the ball and deflect the ball backwards at worst, if not backwards and downwards, to remain in the hole.

This key requirement for rolling a ball into a hole so it stays in the hole has exact quantifications in its timing properties. The exact time that gravity always takes to lower a ball half its diameter once it becomes airborne over the hole is exactly 0.067 seconds — quicker than a quick finger snap. To see this personally, and to experience its unvarying timing, simply place a ball on the palm of your hand, lift it one-half diameter high, and drop it, over and over, watching the sameness of the timing and the timing itself. "It is what it is." and knowing this is more important than knowing the number, which is simply an abstract convention of human society. The golfer must adapt to the facts as they really are, without intermediate abstractions.

The two factors that determine whether a putted ball will have this minimum drop time are 1) the length of the airborne path across the hole, and 2) the lateral speed of the ball across the airborne path. Even though the drop time is quick, and even if the path across the hole is the maximum length (as is the centercut path), there is still an upper speed limit for lateral delivery speed that is simply too fast, and nothing above that speed has any chance of dropping. That upper limit is around 50-60 inches per second, depending a little on the characteristic firmness of the dirt in the back wall and the sharpness of the rim and the cover material of the ball. This velocity equates to about 9 revolutions of the ball per second (rps). For safety sake, no golfer should consider trying to deliver a rolling ball

to the front of the lip faster than 8 revolutions per second, and then the putt had better be centercut. For comparison, a tractor trailer truck driving on the Interstate at 60-70 miles per hours has tires revolving at about 7-8 revolutions per second (rps). (See my study, Touch: Ball-Hole Capture Physics and Optimal Delivery Speed — What's the best overall pace for putts when the ball arrives at the cup?, Puttingzone.com, <http://puttingzone.com/capture.html>).



The combination of path length across the hole and lateral speed determines the practical effective width of the hole as a target that might capture a rolling ball. The effective target width at 8 rps at the lip is a “hole” little more than one dimple wide — a putt that crosses the hole one dimple left or right of this centercut line has practically no chance of staying in the hole.

As the delivery speed is slowed 1 rps in steps, the effective width of the hole as target broadens approximately one-half inch on center for each step down in speed. Thus, roughly speaking, a delivery speed of 7 rps has a possible target one-quarter inch to either side of the centercut line (total of one-half inch wide); 6 rps has a target one inch wide; 5 rps has a target 1.5 inches wide; 4 rps has a target 2 inches wide; 3 rps has a target 2.5 inches wide; 2 rps has a target 3 inches wide; 1 rps has a target 3.5 inches wide; and 0+ a little rps has a target that is about 100% or 4.25 inches wide.

The common sense of the instincts adapts quite nicely to this physics reality in something like the following fanciful manner: The instincts sensibly recognize three factors to balance in optimizing the delivery speed: 1) the need to reach the hole; 2) the need to preserve a wide target; and 3) the need to minimize comeback length. Polling each factor personally, the instincts ask first Mr Comeback what speed he would choose between 1 rps and about 4 rps, and Mr. Comeback readily answers, "1 rps, as I do not want long comebacks." The instincts then poll Mr. Holewidth, who similarly answers: "1 rps of course, as this allows the widest possible target for the greatest chance of sinking the putt." The instincts then ask Mr Getitthere, who snappily answers: "I have to have at least 4 rps!" So there is a problem reaching consensus. Mr Comeback and Mr Holewidth then query whether Mr Getitthere REALLY requires as much as 4 rps, or whether he could do as well with only 1 rps. Mr Getitthere then soberly responds: "Well, I honestly think 1 rps is too slow, but I do not feel uncomfortable with 3 rps, especially since today's greens are in pretty good shape compared to what they used to be." Mr Comeback and Mr Holewidth then propose a compromise: "Suppose we all agree to use 2-3 rps for our general purposes?" To which all three assent.

This is precisely the delivery speed on today's greens that the instincts of ANY golfer would arrive at in the absence of countervailing advice from a well-meaning golf instructor.

OBSERVING OPTIMAL DELIVERY SPEED.

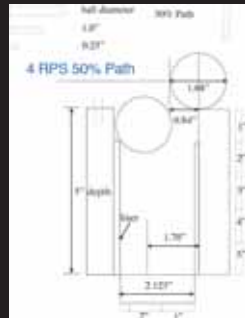
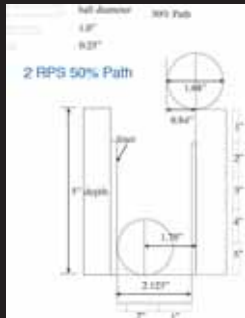
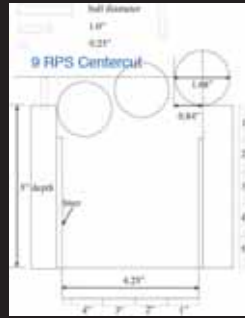
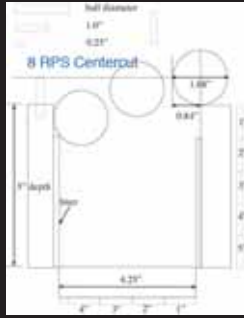
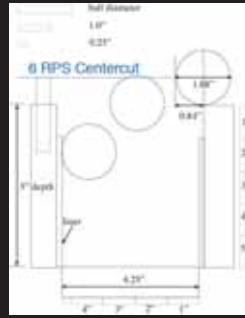
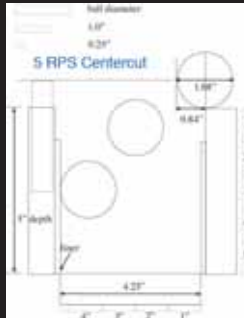
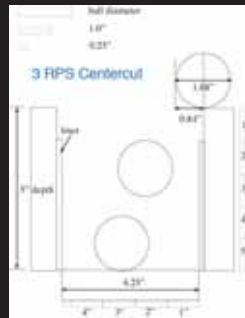
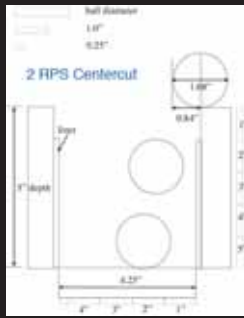
The usual objection to teaching delivery speed is that "golfers don't relate to this" and instead understand much better the distance that a ball rolls past in the case of a miss. This, of course, is nonsense. The distance the ball rolls past the hole is not directly related to the physics reality of ball capture, and the same delivery speed for optimal capture rolls different distances past the hole depending upon that day's green speed,

differences in the speed of one green versus others in the same round, and whether there is any uphill or downhill involved.

The correct way to appreciate one's actual delivery speed is to know how the different speeds result in the trajectory of the ball as it drops into the cup. A ball at 8 rps that is centercut will transit the hole while dropping about one-half diameter and impact the back wall with the equator just lower than the rim. A ball that is centercut traveling at 7 rps will drop further and impact the back wall lower than that, perhaps at the top of the cup liner one inch lower than the rim. A 6 rps speed crossing centercut drops another inch or more deeper before hitting the back wall. A 5 rps ball drops nearly to the bottom of the wall. A 4 rps centercut putt drops all the way down to where the back wall meets the floor of the cup. A 3 rps ball centercut never reaches the back wall and instead impacts the floor of the cup between the central hole for the flag and the back wall. A 2 rps ball impacts the floor dead center. A 1 rps ball drops to the floor between the central hole and the front wall.

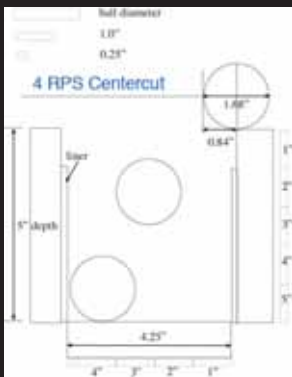
Putts that drop with 1-4 rps on the centercut line are "safe", whereas putts that drop at 5-6 rps are "risky", and putts that drop in the 7-9 rps range are unduly risky or "unsafe" even when centercut. Unfortunately, golfers do not achieve centercut putting with sufficient regularity to use the full range of these "safe" or even "risky" speeds.

A more sensible approach is to consider the "safety" of delivery speeds along shorter paths out to the side of the hole where the transit path is half as long as centercut. If the centercut path across the standard hole is 4.25", one-half this is 2.125". Centering two of these shorter segments at the center of the hole aligned front to back and then sliding them left and right until the end points match up with the circular perimeter of the hole or rim, the distance from the center of the hole out to the middle of these segments is 1.86" so the diameter left-right of this wider half-across hole is 3.72" com-

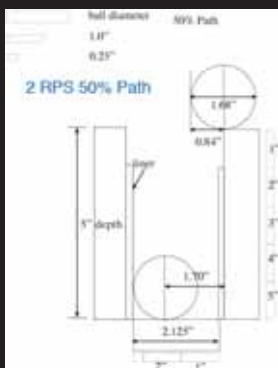


pared to the full hole width of 4.25". So the half-across hole is an ample 87% of the full hole's width, available for capturing rolling balls.

Because the path is halved, the time for dropping is halved as well, so the balls only drop half as far as they did when centercut, dropping as if they are doubled their centercut speed. At this half-across path, a 4 rps ball acts like an 8 rps ball, impacting above the cup liner (not safe). The 3 rps ball acts like the 6 rps ball and impacts the back wall somewhat high (risky). The 2 rps ball, however, is no worse than the centercut 4 rps ball, and still dives deep to the bottom of the wall even this far off to the side of centercut. The clear message of reality is that 2 rps is optimal, with errors trending no higher than 3 rps.



4 rps is safe only if centercut.



2-3 rps is safe even if not centercut.



A golfer who understands how different pace putts dive into the hole (or not) is empowered to receive rich feedback about touch every time he or she watches the ball drop in the cup.

As explained further below in connection with green reading, a golfer with consistent “touch” will very consistently deliver all balls to all cups with very nearly the same terminal delivery speed. For any given putt (e.g., a 15-footer), the golfer will not know much if anything about the speed of the ball at the beginning of the putt, and will ONLY know what to expect about the speed of the ball at the end of the putt, where all balls end their rolls in the same manner over the last 3-4 feet of the putt. Watching the “roll-out” at the ends of putts (and the “drop”) is the quickest way to focus on the relevant cues that teach the brain and instincts how to command distance control.

FIVE FACTORS FOR INSTINCTIVE TOUCH.

The ability to stop a rolling ball where intended instinctively involves five factors in physics and human movement science:

- 1) the mass of the putter head;
- 2) the cover material of the ball;
- 3) the green speed (including uphill / downhill effects);
- 4) the golfer’s tempo back and thru; and
- 5) the golfer’s sense of the distance of the putt.

Of these five factors for instinctive putting, the golfer simply gets “used to” the first four, and the only factor normally in play on any given putt is targeting.

The putter head mass matters since two putter heads with differing mass impacting the same ball on the same green at exactly the same impact velocity will send the ball two different distances, the more massive / weightier putter having greater momentum and force at impact. This hardly matters unless the golfer switches putters often, as a basic familiarity with the heft of the tool is all that is required for instinctive use.

The ball cover material matters a bit, as a softer ball like a balata ball absorbs the force of impact more and rolls a shorter distance than a hard-cover “distance” or “surlyn” ball. Roughly speaking, when a balata ball rolls ten feet, the surlyn ball will roll 11 feet for exactly the same impact force, as an outside range. Again, this hardly matters so long as the golfer practices with the same type ball as used for play or at worse switches ball types knowingly and becomes freshly familiar with the new cover material. One possible occasion for switching ball cover types might be to use a hard-cover ball on slow greens, when the golfer primarily plays soft-cover balls on fast greens.

Green speed doesn’t matter — *appreciating* the green’s speed matters. (“It is what it is, whatever it is.”) This is discussed in detail below, but for present purposes, the golfer should always arrive at a round of golf and test the green speed of the practice green with “core putts” to register his or her stroke, putter, and ball to that day’s surface speed. Once calibrated to the basic speed of the greens for level putts, the golfer can then explore uphill and downhill effects and is essentially primed for using this factor during the round.

Whatever the golfer’s tempo, he or she needs to have a present familiarity with this usual timing throughout the round. In the pre-round warm-up, the golfer becomes reacquainted with the tempo and makes sure he or she has a good sense of the timing. On each hole, for every putt, the player uses the familiar timing pattern.

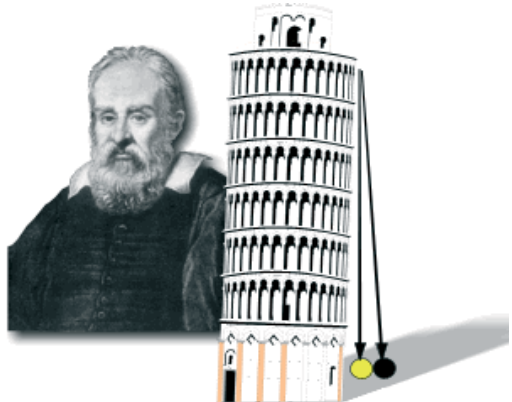
Other than this, these four factors operate in the background for the vast majority of putts, and only targeting is in play on every putt. With green speed being fairly straight forward, the important factors to explore are tempo and targeting. As will be seen, timing is key to touch, reading and stroke, and is by far the most important factor in putting.

DEFINITION OF TEMPO.

Distance control is the key to touch and putt reading, and TEMPO is the key to distance control and an accurate and repeating stroke. The term “tempo” is here used to embrace both the timing pattern of the backstroke and the timing pattern of the downstroke. A true pendulum has a “period” or tempo that depends solely upon the length of the pendular rod, and the “period” is usually timed from the top of the backstroke to the top of the thru-stroke and back again (one cycle or 1 Hz). For our purposes, the critical timing pattern is that from either the top of the backstroke to the top of the thru-stroke or vice versa. The backstroke per se, starting from a dead stop at the static address position, is not really part of pendular motion. So the term “tempo” as used for putting concerns both the timing pattern of the backstroke from start at address position to top of backstroke, and the timing pattern of the downstroke to impact and to the top of the thru-stroke (top to top).

GRAVITY AS FUNDAMENTAL FACT FOR MOVEMENT.

On earth, gravity exerts the same force on all objects on the surface of the planet, and has been doing so since the planet attained its current size and mass billions of years ago. This force attracts objects and bodies to the center of the planet in a way that accelerates the



object in a downward free-fall. The rate of acceleration is the same for all objects regardless of differences of size or mass or weight, wind resistance and friction aside, as Galileo demonstrated from atop the Leaning Tower of Pisa — a light ball and heavy ball released at the same moment always fall side-by-

side the entire distance to the ground and hit simultaneously.

Every object on earth when allowed to start free-fall gains a velocity towards the center of the earth at the steady, constant, equal rate of 32 feet per second every second (or the same, 9.8 meters per second every second). A golf ball dropped from a height of 16 feet starts at zero velocity and accelerates smoothly up to 32 feet per second at the end of exactly one second, and then continues accelerating to 64 feet per second at the end of two second's of free-fall, etc. The average velocity during this first second is 16 feet per second, since the ball started at zero and sped up to 32 feet per second. So how far has the ball fallen in exactly one second? 16 feet (average speed of 16 fps for 1 second). This means you can hold a ball at a height of 16 feet, drop it, and see exactly how long a second really takes, as the ball will hit the floor right on the button in one second. The same timing holds for a 20-pound bowling ball or a light-weight rubber ball released from the same height. And this timing never changes, and has always been the same, and will remain the same so long as we all live on this planet.

GRAVITY AS TIMING, OBJECTS IN MOTION AS FORCES.

Gravity is the timing that all movement is conditioned by on earth. Anything that moves — whether up, down, sideways, or in a circle or some other pattern — moves to varying extents against or with the ever-present force of gravity. And simply put, “movement” is change of position over a certain span of time. The timing of gravity is utterly predictable not only because gravity always affects the same object in the same way, but because it has the same timing influence on all objects of all sizes on earth. If you lift a bowling ball and a golf ball to a height of 16 feet, it is obviously “harder” (requires more energy or work) to move the bowling ball against gravity when raising it to the higher position, but this doesn't matter to the timing of the free-fall: upon simultaneous release, both the bowling ball and golf ball fall side-by-side the whole way down to the floor

and hit the floor on exactly the same moment.

When the brain experiences gravity by movement, it learns an association between the forces required to move different body parts up against gravity or down with gravity and also learns a free-fall timing as the body part moves downward. The essential model of all movement is the ball toss straight up, as in the toss for a tennis serve. This simple case reveals many aspects of how gravity conditions movement.

A tennis ball tossed straight up departs the hand with a given upward force and velocity. Gravity immediately starts to slow the ball down according to the usual timing, dragging it back earthward in a negative way with increasing downward velocity working to slow and stop and then reverse the upward velocity of the tossed ball. A ball tossed at 50 feet per second when it leaves the hand will be slowed by gravity at the end of



one second by (negative) 32 feet per second. At the end of the first second, then, the tennis ball will slow under gravity's pull to only 18 feet per second. Shortly thereafter, the tennis ball will reach its peak height when the upward velocity has been slowed all the way to zero.

This slowing is always the same smooth pattern of "coasting" to the peak, where the ball appears to "pause" as it changes direction from up to down.

Once the ball coasts to its peak height and slows to zero upward velocity, gravity continues to pull it back to earth with the same force and timing as usual. The ball starts dropping and smoothly gains velocity as it fall until it hits the floor, court surface or ground or is swatted away by the racket.

The "force" (technically, "momentum" is mass x velocity while force is mass x acceleration) of an object in motion is simply

the combined effect of its mass and its velocity. A bowling ball dropped from the leaning tower of Pisa hits the ground with much more “force” than a golf ball falling the same height and hitting the ground at the same velocity. A penny dropped from the Empire State Building falls so long under the acceleration of gravity that it hits the sidewalk at a tremendous velocity, and even though its mass is small, the combined effect of small mass and tremendous velocity makes the momentum of impact great, and the penny will bury in the concrete. A bullet is another example of a small mass moving fast and hence with great momentum.

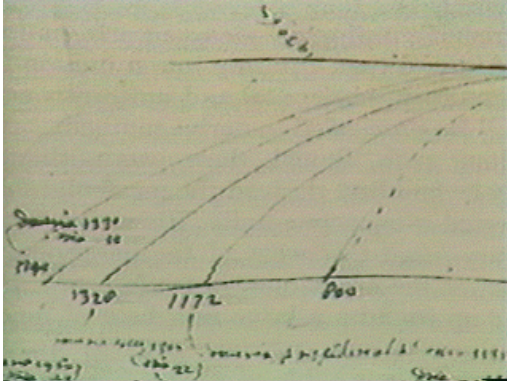


In the opposite direction, holding a bus from rolling downhill is much more difficult (takes more force) than holding a bicycle, and moving a refrigerator is harder than moving the empty box it came in. Hence, if the brain is familiar with the mass of an object, it will also become familiar with the forces required to move that object against or with gravity. The body and the parts of the body are by far the masses and forces that the brain learns most often and most deeply.

The brain adapts to the reality of life on earth for purposes of action by learning timing and force. All brains are adaptive to the same timing influence of gravity and the forces of their body and body parts when moving in gravity are also uniquely known by each animal. These fundamental associations underlie the adaptive behaviors for action by which animals successfully fit within the reality of life on earth.

GRAVITY AND MOVEMENT ON EARTH.

Gravity “moves” all objects on earth downward with the same force and acceleration pattern. Objects that are “moved” sideways or upwards by something other than gravity are dropped or opposed (dragged down) by this countervailing downward force. A tennis ball tossed straight up is slowed to a stop at its



The arc of cannon balls
from Galileo's *Two New Sciences* (1638).

peak height and reverses direction. Likewise, a cannon ball fired horizontally across the ocean will immediately begin to lose height above the sea and in an amount of time fixed solely by the starting height and always-the-same gravity, the cannon ball will drop and impact the surface.

Because all objects of different masses and weights “free fall” in the same way in gravity, the mass differences of objects do not matter to the timing of the falling. This common timing of all objects “free-falling in earth’s gravity” is demonstrated by Galileo’s experiment of dropping two objects of the same shape but different masses — for example, two balls the same size with one weighing much more than the other — from the leaning Tower of Pisa: both balls accelerate side-by-side the whole way down and strike the earth at exactly the same instant. Indeed, if Galileo himself had joined the balls by leaping off the balcony, he and the two balls would fall simultaneously at the same rate, with the balls seeming to float with apparent “weightlessness” beside him as the three fell together.

In “free fall”, the center of gravity of an object falls only straight to the center of the earth. Otherwise, “non-free fall” motion is the downward acceleration of mass that is con-

nected to other mass, such as the fall of a foot at the end of a forward step — the foot falling at the end of the leg also falling about its connection to the hip. This sort of fall pivots about a common center of mass out from the pivot.

A pendulum is “non-free fall” motion in the special case where the point of fixation of the stick is stabilized by supports so that the pivot point itself is “balanced” in gravity and is otherwise not moved by the swinging of the pendular rod and bob beneath it. An “ideal” pendulum is an abstract conception of a pendulum free of friction at the pivot, not experiencing air resistance against the rod or bob, with a rod that is a line without mass or extension, and with a bob that is some mass concentrated in a single point without extension so that its “center of gravity” is coincident with the location of the bob. A “real” pendulum in contrast has extension in space due to its shape and mass distribution, has a “center of gravity” somewhere other than the end of the rod, and rotates about a common “moment of inertia” subject to friction and air resistance.

PHYSICS CHARACTERISTICS OF PENDULAR MOTION.

In the pattern of pendular motion, the important aspects are: total time of the parts and the whole, pattern(s) of acceleration, peak velocity at impact, and rhythm or proportionate timing of sections of the total stroke motion. In a true pendulum motion, the bob descends at the end of the rod under the gradual and smooth and constant acceleration of gravity from zero velocity at the top of the backstroke to a peak velocity exactly at the bottom / middle of the stroke, and then the bob ascends against gravity past the bottom with gradual, smooth and constant deceleration until the bob slows to zero velocity at the top of the thru-stroke, which is the same height and amplitude

as the backstroke (ignoring vagaries of air resistance and friction). Because of this, the timing from the top of the backstroke to impact or to the bottom of the stroke is one-half the total time for the swing from one side to another.

2-to-1, write it down! Pendular motion has a 2-to-1 relationship between the timing of the full stroke from thru-top to back-top (1 unit) or from start to back-top (1 unit) and the timing from back-top to impact (1/2 unit).

Another important aspect of pendular motion is "isochrony": a small backstroke and a large backstroke take exactly the same time to swing to impact and to swing to the top. Indeed all strokes out to a limiting angle of 30 degrees or so take exactly the same time. In other words, for a given length pendulum, all backstrokes generate swings that take exactly one time. If any golfer uses a tempo that features "smooth" acceleration back and thru, this stroke will also have isochronous timing for all size strokes, and otherwise not.

All strokes of different sizes take the same time only if ... Isochrony, or the same timing for all size strokes, depends upon "smooth" acceleration, as characterizes gravity. Other strokes without this acceleration "smoothness" will lack isochrony and different size strokes will not take the same time.

The ratio of the parts of a complex motion like a back-and-thru putting stroke should be fixed and steady. The tempo is the "quickness" or "slowness" with which the parts are executed in sequence. Hence, the parts are like the notes in music (whole, half, quarter, etc.), but the "tempo" is the overall pace of the music.

Notwithstanding that all four quarter notes in a measure of 4:4 time are equal in duration, the time required to play the measure is determined by the tempo: an *allegro* tempo gets through the four notes of the measure faster than a *largo*

tempo. In the terminology of western musical tradition, a “one second” tempo corresponds to 60 beats per minute, which in turn is defined musically as somewhere between “*largo*”, “*larghetto*” and “*adagio*”.

A final important point to note about the swing of a pendulum is the relationship between the backstroke size and the peak velocity of the bob at the bottom of the stroke. In particular, for each separate backstroke length or size, there corresponds one and only one peak velocity at the bottom of the stroke (impact in a putting stroke). This is because the different lengths of the downward arc admit greater or lesser applications of same-for-all acceleration, such that a longer arc reaches the bottom with a faster velocity (peak speed) than a shorter arc.

Size determines velocity of impact. Every backstroke size with smooth downstroke acceleration results in a unique peak velocity, and that size and velocity remain matched so long as the golfer sticks to one downstroke acceleration pattern. Each added increment of backstroke size corresponds to an increase in peak velocity.

Since mass times velocity is force, the backstroke size also uniquely determines the force of impact. In the context of an instinctive stroke in which the non-conscious sets the size of the backstroke, the non-conscious is thereby selecting the force for the putt. If the instincts are correct and accurate in this selection of the backstroke size, then the backstroke is pre-loaded with 100% of the distance for the putt. Accordingly, anything the golfer might do voluntarily to alter the downstroke timing by speeding it up or slowing it down will result in a putt that is too short or too long.

Force determines distance, peak velocity determines force, and backstroke size determines peak velocity, but only if the acceleration pattern is smooth. So what determines backstroke size? Instincts — more of which later.

INHERENT TIMING OF PENDULA ON EARTH.

Every stick on earth without oddities of shape and mass (i.e., essentially “rod-like”) is potentially a pendulum timing system, as its length primarily determines the timing of its swing. Any stick that is fixed at one end and suspended freely in gravity swings with pendular motion beneath its pivot. Accordingly, a conventional putter of 35 inches has one and only one inherent pendular timing, and all putters of the same length have pretty closely the same timing, gross differences of shape and mass aside.



If one suspends such a putter between thumb and index finger holding the top of the grip lightly and then pulls the putter back in a backstroke and releases it so that it swings naturally like a

pendulum, the time of the stroke imparted by gravity alone is about one second from side to side.

This timing is not simply coincidentally the same as the basic unit of human time. Christian Huygens originally proposed a definition of the “meter stick” as a unit of whatever length such that the pendular swing of the stick in gravity has a period of one second from side to side. (Mahoney, 1980). The French Academy of Sciences in 1791 ultimately rejected this proposal due to slight variances in gravity around the not-so-round planet and chose instead 1/10,000,000 the distance of the meridian from pole to pole. Even so, a meter stick turns out to be a stick that is 39.37 inches in length and swings with a period of one second. The length of a conventional 35-inch putter

closely matches the length of a meter stick, and the meter stick and a conventional putter swing with very nearly the same gravity timing — about one second.

The adult human arm is also a “stick” and thus a pendulum, and most adult arms are about as long from base of neck to end of hand as a conventional putter or a meter stick. (This similarity of timing also is likely at least partly the explanation for why conventional putters are the length that they are.) Every day of adult life, the natural pendular swinging of the arms in a relaxed fashion effectively “teaches” the human brain about the timing aspects of movement in gravity. Repeated hundreds if not thousands of times each day, the relaxing of the arm that allows it to fall and strike the side of the body takes about one-half a second, and this relentless repetition buries gravity’s basic timing deep in the human brain.

GRAVITY TIMING AND INSTINCT.

The innate sense of gravity timing in the human brain underlies the ability of people to toss a ball into the air, note its height at the top of the toss, and then “know” instinctively when the ball will fall back to the height of the waiting hand so as to time the closing of the hand on the ball at the right moment to catch it. People ordinarily “know” this timing even without watching the ball fall from its height or relying upon so-called “hand-eye coordination” to time the catch. Expert tennis players have a well-learned height of ball toss for service that is higher than a fully extended racket’s sweetspot by precisely the extra distance that corresponds to the timing of making the service stroke once the ball is released in the toss, reaches its peak height, and then starts free-falling back down. The racket sweetspot in the service stroke then meets the falling ball right on time.

The brain makes movement effective because the brain uses timing to “predict in advance” the consequences in gravity of different muscle movements on body parts. (Berthoz, 2000;

Llinas, 2001). All brains are in effect “flight simulators” used to plan movement so that the influence of gravity and the mass and muscle properties of the moving part(s) are known in advance how these aspects determine the total consequences of voluntary movement. (Berthoz, 2000). Once the voluntary movement is made in opposition to gravity, the total resulting motion is a combination of the result of the animal and gravity: movement has both voluntary and involuntary aspects. If a person tosses his arm casually out from his or her side and then watches what happens, the arm swings upwards a certain distance based upon the initial voluntary thrust, the motion gradually comes involuntarily to a halt and reverses direction, and then the arm involuntarily drops back against the thigh in a pendular motion. The human only “does” the move away.

Accordingly, since all motion is subject to gravity’s constant influence, animal brains “instinctively” learn and adapt to gravity timing in order to move effectively. Unless the animal adapts to this reality of life on earth, its movements are ineffectual and the animal likely will not survive. If in fact an animal survives to adulthood by virtue of its movements during life, this is proof positive that the animal’s brain “knows” gravity timing and has adapted in order to make effective movements.

HUMAN INSTINCT AND GRAVITY TIMING.

The human brain has evolved from the preceding animal brains, usually by a process of addition and refinement without abandonment. The one thing that the human brain inherits from the animal brain that does not require much tweaking is the ability to generate effective movement. That is, the animal brain and the human brain are both effectively adapted to gravity timing. The part of the human brain that is least unchanged from the animal brain is the cerebellum (the “little brain” attached to the back of the base of the brain). In the animal kingdom, humans are quite good as a species for movements.

The cerebellum in animal and human brains coordinates the body in space for movement by coordinating vision, balance, and body positions. Not surprisingly, the cerebellum has exquisite timing as its most fundamental property in this coordination. (Llinas, 2001).

The human cerebellum is not part of the human conscious experience in the cortex of the cerebrum proper. Instead, the cerebellum is just another organ of biological tissue structured and arranged to perform its normal function, the same as a kidney or liver. Because of this, the “instinct” for movement is first and foremost a NON-conscious functioning of an organ of the body, and movement is only derivatively “known” in the conscious mind as a result of NON-conscious functioning.

As a matter of survival value, it is much more effective to have movement committed to non-conscious processes, not so much because these processes are “automatic” in some robotics or machinery sense, but because the conscious brain has so many other fishes to fry that it controls movement only poorly and inefficiently. The more the animal has a conscious experience (cognition, language, memory, sense of self, and the like), the more important it becomes to isolate the movement processes from these other brain processes. For this reason, in the evolution of the human cerebellum, the cerebellum and its essential timing and movement functions have been removed from the cerebrum and relocated outside the conscious pathways at the back of the brain.



THE STRENGTH OF INSTINCTIVE GRAVITY TIMING.

The European Space Agency (ESA) in 1998 hired French neuroscientist Alain Berthoz to conduct experiments on the strength of gravity timing in the cerebellum, using the ability of Russian astronauts to catch a tossed ball as a probe to cerebellar timing



Alain Berthoz
Collège de France, Laboratory
of Physiology of Perception
and Action

processes on earth versus those applied in the microgravity of space. On earth, the astronauts had no difficulty timing the catch of a ball free-falling in gravity, as usual. But in the microgravity of orbit, the experiment directed the ball across the cabin not with gravity acceleration but with a constant velocity. In this case, the astronauts invariably timed the closing of the hand to catch the ball too early, notwithstanding hand-eye coordination and advanced knowledge of the motion of objects in microgravity space. (Berthoz, 2000).

This indicates that cerebellar timing of gravity overrides hand-eye coordination as well as conscious processes. The astronauts required about 15 days practicing the “unusual” ball speed before overcoming the instinctive gravity timing habit. In comparison, the human visual system can be completely flipped upside down with special prism goggles so that a person “sees” the floor as the “ceiling” and wonders why standing on this “ceiling” upside down does not result in “falling” on one’s head onto the “floor” that used to be a ceiling, but this disturbed visual sense is completely adapted to within 3-5 days. Thereafter, even though the world is still inverted, the person “sees” this as normal. Upon removing the goggles, the person’s visual world again looks wrong and inverted, and this sense dissipates in another 3-5 days. (Kohler, 1961; Kohler, 1964). Hence, gravity timing in the instincts is FIVE TIMES

STRONGER and harder to ignore than the entire human sense of vision.

The “Ball Catching Experiment” during the Neurolab STS-90 mission in microgravity.

From G. Seibert et al. (2001). *A World Without Gravity*. (Noordwijk, The Netherlands: European Space Agency, 2001), p. 103.



As summarized by Harvard University Press:

“In Berthoz’s view, perception and cognition are inherently predictive, functioning to allow us to anticipate the consequences of current or potential actions. The brain acts like a simulator that is constantly inventing models to project onto the changing world, models that are corrected by steady, minute feedback from the world. We move in the direction we are looking, anticipate the trajectory of a falling ball, recover when we stumble, and continually update our own physical position, all thanks to this sense of movement.”

(Harvard University Press, <http://www.hup.harvard.edu/catalog/BERBRA.html>). These innumerable microexperiences are all uniformly conditioned by the constant influence of gravity on earth, from cradle to grave, teaching all moving animals throughout the span of life on earth.

CHOOSING AN OPTIMAL TEMPO.

Different tempos can work well, but your tempo ought always to be the same. With a stable tempo and smooth acceleration, every stroke will take exactly the same time — the backstroke from start to top of backstroke, the downstroke from top of

backstroke to impact, and the thru-stroke from impact to top of follow-thru — regardless of the length of the putt or the length of the backstroke. The pattern of smooth and gradual acceleration down is always the same.

A timing pattern for optimal movement performance has to respect the inherent timing properties of objects and masses in both voluntary and involuntary aspects of motion, and also likely needs to avoid conscious processes for effectiveness. In addition, a quicker timing pattern results in greater momentum of masses and greater “forces” of the moving parts influencing the non-moving parts, raising control issues with added speed.

As already noted, the backstroke movement must be voluntarily initiated against gravity, but so far as the downstroke is concerned, the chosen timing pattern can be either involuntary or voluntary or a blend, and the upstroke from the bottom into the follow-thru can be either the continuing result of the downstroke or partially due to independent voluntary movement.

A voluntarily generated timing pattern always begins as a conscious movement, and only by dint of overlearning thru practice and repetition does the brain transfer control from conscious to non-conscious or “habitual” processes. The key to whether this transfer process truly and completely shifts control to the non-conscious processes is the extent to which the voluntary action depends upon a conscious association for its planning and execution. For example, the voluntary making of a backstroke according to the conscious “rule” that every inch of backstroke length will result in the ball rolling one foot across the green (Rodgers, 1982) is doomed at the outset never to become a non-conscious movement process, regardless of practice.

In order to transfer a voluntarily chosen timing pattern to non-conscious processes, ultimately the original conscious associa-

tion has to be abandoned and replaced with a non-conscious association instead.

In contrast, an “instinctive” movement relies upon non-conscious associations to begin with. The cerebellum is preloaded with certain non-conscious associations from the human experience in gravity, including the association between a given voluntary force that tosses back the arm (or the arm plus the added load of your familiar putter) and the exact size of backstroke that results in gravity, the association between how much time it takes the arm to free-fall against the side, and the association between how far back the arm started at its free-falling and how much velocity and thus force it will have at the moment of impact against the thigh (size, timing, force). Because the instincts integrate perceptions (distance, green speed, putter heft and ball response) with stroke time, size, and force, the forging of the non-conscious link is simply learning how to “join in” with the internal model of the swinging of the putter back and forth according to the usual tempo.

Even though the initiation of the backstroke is somewhat voluntary and hence conscious, the timing of “joining in” with the internal model of the stroke tempo renders the important aspects of the backstroke instinctive and non-conscious. In particular, the “ballistic” force of the initial takeaway move is calibrated instinctively, and the final extent of this ballistic takeaway that results as the stroke is opposed by gravity to coast to the top of the backstroke is similarly without conscious involvement by the golfer. The instinctive golfer never chooses the size of the backstroke. In terms of the pattern of muscle activation, the golfer does not “brake” the stroke and thereby define a specific backstroke size. The usual “reach and grasp” pattern is termed the “tri-phasic” pattern, in which the initial ballistic motion is slowed to control the approach to the target object, and then is held in the final position by something of a “clamping” action of the muscles. (Hallett et al., 1975; Winters, 2007). The instinctive backstroke, in con-

trast, “inhibits” the tri-phasic braking and clamping pattern in favor of allowing the stroke motion, once started, to glide to its own completion in a relaxed flowing. This sort of backstroke is strongly correlated with a deliberate indifference to the size of stroke that results, in order to avoid conscious engagement with the movement size. The instinctive golfer simply starts the stroke back to join in with the usual tempo, and that’s all.

If the golfer feels a need to “control” the size of the backstroke, that is a sign that this golfer is a) unfamiliar with how exquisitely nuanced the instincts are for the backstroke size in light of the facts of a given putt, and b) fearful of the absence of conscious control. The only way thru this difficult impasse is exploration and experimentation with instinctive strokes until the conscious mind “gets it” and then “gets out of the way”.

“A good putting stroke is completely natural. What is an accelerating stroke? This will give you a clue: With your left thumb and forefinger, hold the putter at the very end of the grip and let it hang in front of you. With your right hand, pull the putterhead back, then let it go so it swings like a pendulum. You applied no force, yet it accelerated through the bottom of the arc. And that swing was about as simple and smooth as they come. If you let gravity and centrifugal force pull the clubhead through the hitting area, you’ll accelerate and you’ll have done it naturally. Don’t fight gravity; use it. Take it back, then let it swing through. Keep grip pressure light so you can feel the clubhead. Even without applying force, the putterhead accelerates through the arc.” — Golf Magazine (1993).

“Then take the club back in one piece to that desired point. The next step is critical. Just let the clubhead fall through the ball. Don’t try to stop it or help it — just let it go and keep your eyes over the spot where the ball lay.” — Golf Magazine (1973).

“Smooth acceleration simply means good rhythm — a free and easy stroke without any sudden movements. The enemy of rhythm is an abrupt change of direction.” — Swash, Harold & Yun, Hunki, Three basics for pure putts: England’s guru of the greens tells you how to knock ‘em in, Golf Dig., 46(12), Dec 1995, 87-88, 90, at 90.

“There was another survey done on putting. Ten of the best putters in the game were tested, and it was found they had very little in common as far as stroke path. Some swung the putter inside to out, some a little inside to square, some straight back and through. But the one thing they all did was stroke the ball within a thousandth of a second at 32 feet per second, which is the force of gravity. They all swung the putter back and through at the same time.” — Rodgers, Phil & Barkow, Al (1986).

One cannot by definition “think about” or deliberately invoke such non-conscious associations, and by the same token “trying” to use them consciously is similarly unworkable. And the effort to give these non-conscious associations conscious definition — for example, by “thinking” that your arm falls in exactly 0.47 seconds against the thigh — does not enhance use of the non-conscious association between arm and truly precise timing. The timing “is what it is, whatever it is” and labeling it with the conventional unit of human society’s unit of time does not help and is probably not exactly correct anyway.

The bottom line is that learning how “instinctive” or “non-conscious” movement processes actually work allows the human to skip the usual “rules” of sports performance in favor of relying upon the “usual” processes of simple adult movement.

With respect to the backstroke, the choice is between a conscious “rule” of some sort and the simple non-conscious association between the force of the start backwards and the resulting extent of the swing, albeit unknowable in advance. The instinctive “rule” for the backstroke is simply “join in with the internal model of the stroke in its usual tempo.”

With respect to the downstroke, the choice is between a deliberately chosen timing and the involuntary timing of gravity. (Beyond impact, the timing doesn’t matter much, so the choice for the tempo of the follow-thru past impact is not critical to accuracy and consistency.) Just riding the putter down as the shoulder frame and putting stroke arrangement of arms,

hands and putter rocks and swings down involuntarily as a unit beneath a stable pivot is the most reliable and the easiest way to ensure accurate timing, since gravity timing in and of itself never varies. In contrast, a voluntarily chosen downstroke timing is variable in execution to the same extent it remains dependent upon conscious association, which is the same as the extent to which the original conscious association remains untransferred and supplanted by a non-conscious association.

WHAT IS A BACKSTROKE?

If a backstroke is not really part of pendular motion, what is it? To the instinctive brain, a “backstroke” that starts from the static address position is a “fake” backstroke of the full pendular swing from the top of the follow-thru back, down and up to the top of the backstroke. The total timing is the same, the coasting to a top of backstroke is the same, but the initial pattern of acceleration differs between the two sorts of “backstrokes.” In the backstroke that starts from the static address position, the pattern of acceleration is “ballistic” in order to catch up with and match the freely accelerating motion of the pendular backstroke so that both strokes arrive at the top of the backstroke at the same instant. In so many words, the instinctive brain conceives of an on-going stroke back and thru, from top to top and back again, over and over, with the usual gravity tempo, and the actual backstroke away from the ball simply meshes with this pattern by “catching up with one of the backstrokes” as it starts down from the top of the follow-thru en route to top of backstroke.

The timing pattern of the backstroke is easy: whatever tempo is usual, make a backstroke that joins into that on-going conception. The force of the ballistic initiation and the resulting size of the backstroke come from the brain’s use of targeting information in light of the green speed, the putter mass, the ball mass, and the golfer’s planned tempo. In metaphorical terms, these factors combine to load the backstroke “cannon” with a specific charge of black powder that results in just the right

size of backstroke of the putter, hands, arms, and shoulders as a unit for the distance, green speed (including uphill / downhill effects), putter, ball, and downstroke tempo. The farther the head-neck turn proceeds in the targeting move at address, the more black powder that is added to the cannon's charge. After the targeting move to polish off the sense of what is required for the distance, the golfer simply "pulls the trigger" with the usual smooth tempo, and the correct backstroke size is the instinctive result, without any conscious effort or even attention.

The Instinctive Backstroke

Joins in with the internal model of the swinging tempo.
 Sizes the backstroke by loading the ballistic start of the takeaway.
 Coasts to the top without the golfer applying the brakes to define size.
 Takes the same time to backstroke top as one full stroke from top to top.
 Takes twice as long going to backstroke top as stroke takes to impact.
 Attains a size of backstroke that relates to only one impact force.
 delivering chosen force depends upon golfer not altering timing.

Because the backstroke "joins in" with the on-going usual tempo back and thru, two timing properties naturally result: 1) the backstroke takes the same time as the full stroke from top of backstroke to top of thru-stroke (as it joins in and matches a conception of the stroke falling backwards from top of thru-stroke to top of backstroke); and 2) the downstroke from top of backstroke to bottom of stroke is one-half the time from side to side. An instinctive tempo then has its backstroke timing based upon the downstroke timing, and in the case of almost all adult humans using conventional putters, the gravity-based downstroke is about one-half a second, the total side-to-side stroke is about one second, and so the backstroke timing itself is also one second.

For this reason, all natural putting strokes of whatever tempo have a 2:1 ratio in the proportion of the parts: the backstroke is twice as long as the downstroke to impact. This ratio persists

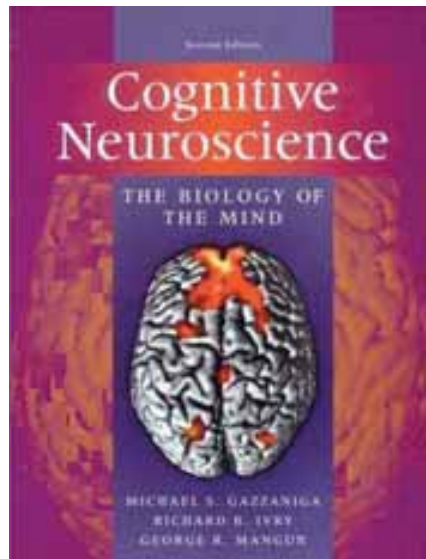
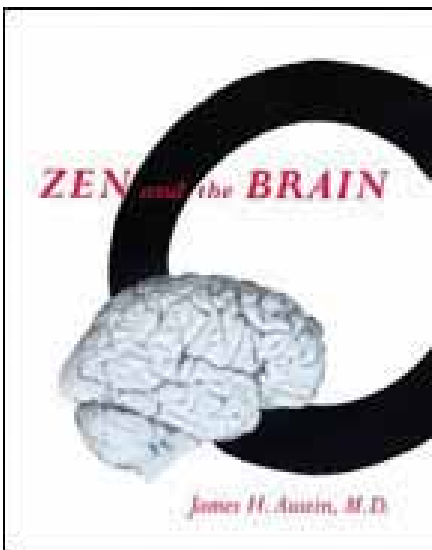
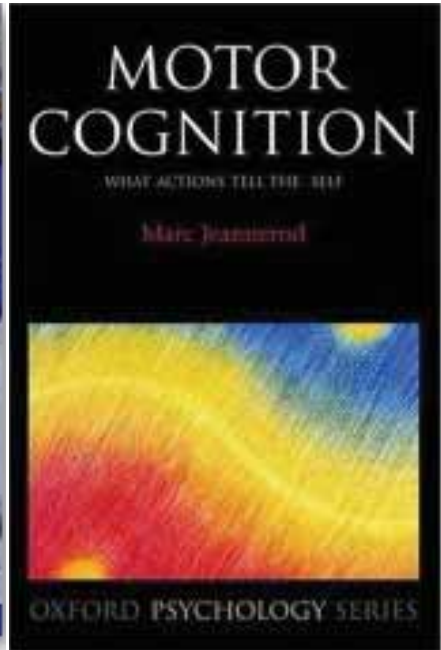
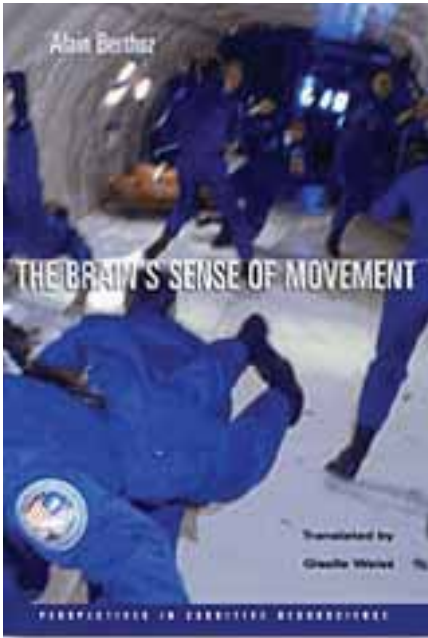
regardless of a player's tempo, fast or slow. A stroke pattern that violates this 2:1 proportionality is less than "natural."

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Chapter 4: Distance Control Praxis.

SKILL 1: PRAXIS OR APPLICATION FOR TOUCH.

GREEN SPEED APPRECIATION.

While it is true that the simple “core putt” exercise on the practice green does great service to informing the instinctive brain about distance control throughout the round, there will inevitably be differences in green speed from green to green. There are a number of rules of thumb about recognizing when a given green is faster or slower than might be anticipated.

1. A green that is located high on a hill exposed to the sun and wind will likely dry out more and be faster than normal;
2. A green that is tucked out of the wind in the shade or down near moist lowlands will likely hold moisture more and be slower than normal;
3. A green that has a rich green color has more water in the grass blades and will be slower;
4. A green whose grass is more tawny or straw-colored will have less water in the leaves and be faster;
5. A green that feels somewhat spongy to walk on is slow;
6. A green that feels like a hard floor is fast;
7. Greens in the early morning still retain water from the preceding cool night’s watering and haven’t had much exposure to the sun yet, and so will be slower than the fresh mowing makes them look;

8. A green where the dew is visible is very slow and the ball's tracking thru the water reduces break dramatically;
9. A green that has numerous irregularities in the surface, such as ball pitch marks, foot prints, or weedy areas (e.g., patches of poa annua), not only will not roll true for line, but the bumpiness will sap the energy from the ball's roll noticeably;
10. A grainy green may have grain patterns in area patches or may have a dominant grain pattern across the green, and these two situations differently affect the distance, with the dominant pattern more uniformly opposing into-grain rolls and more uniformly smoothing the way for down-grain rolls;
11. Greens late in the day have grown since the morning mowing and are slower than early-day greens;

GREEN SPEED APPRECIATION FROM CORE PUTT.

Green speed in the abstract doesn't matter nearly as much to effective touch as does simply appreciating what the green speed actually is in terms of your personal stroke, putter, and ball. Getting an appreciation for green speed can come from just hitting some putts and letting it grow on you, or by making a very specific backstroke with perfect tempo and waiting to see what distance results. I call this latter approach the "Core Putt" as there is one backstroke length you can repeat every time, which is a backstroke that just gets outside the back foot to a point where it would require your lifting the putter head to get the putter further back.

By using one specific backstroke size, combined with the usual downstroke tempo, the result is a putter head speed at impact that is the same time after time. This makes any golfer into a "personal Stimpmeter", which is simply a mechanical device or ramp for giving ball after ball the same velocity off



CORE PUTT TO REGISTER GREEN SPEED TO PERSONAL STROKE
Top: two stroke with identical backstroke sizes and impact speeds.
Bottom: Same-speed strokes send the two balls the same distance.
(At Greensboro County Club, Donald Ross course 1909).

the bottom of the ramp. No one really cares if needs to “know the Stimp” as a number; what matters is how your stroke, putter and ball work out on a specific green speed in the here and now (“it is what it is, whatever it is”).

To perform the core putt, once this backstroke point is reached, just let that be the backstroke length and go from there to see what sort of distance of roll the specific green will allow. You should be able to send two balls rolling off with this same stroke and tempo so that the second exactly bumps the first. If the balls go different distances, you didn't get the stroke or the tempo or both exactly the same twice, so do it again. Once the balls bump, you have a calibration of what your core putt produces on this green, and the brain will soak that dis-

tance in and correlate it with your core backstroke. All other backstrokes on that green speed are built around this core targeting distance.

Now you can TARGET that same core distance, and your instinctively occurring backstroke ought to perfectly match your core backstroke. And shorter putts have a shorter backstroke and longer putts have a longer backstroke. Now you have TOUCH simplified to TARGETING. Look and go, so long as you know how and why to look in a certain pattern.

Tom Watson uses a version of the “core putt” to find out how his usual stroke plays out on the green speed “du jour”: he makes a backstroke that takes the putter back to right big toe and then accelerates normally into the ball and waits to see how far it goes; this distance he then uses as a gauge for all other backstrokes. (Watson, 1980).

Bobby Locke reportedly stated his warmup on the practice green stroking a ball to nowhere in particular and then stroking a second ball the same distance, used as a registering of the green speed in terms of his usual stroke and tempo.

TOUCH FOR DIFFERENT DISTANCES.

A longer stroke just moves faster at the peak speed at the bottom than a short stroke, since the natural and gradual acceleration downward has a longer arc to travel in increasing the putter head speed in a longer fall from a higher backstroke. The analogy is stepping on the accelerator as a traffic light changes and mashing the pedal exactly 2” down and then waiting one block to see what speed results (15 mph), and then seeing the speed after two blocks (30 mph), etc.

There is a one-to-one correspondence between any and all different backstroke lengths (heights of fall of the putter head for the arc of your stroke), then, and peak putter head speed at impact (or strictly speaking, at the bottom of the stroke). The brain already instinctively “knows” the association in a

non-conscious form between a backstroke size and the impact force that results from a gravity swing. For other timing patterns, the association may be non-conscious to varying degrees.

Aultman, Dick (1994): "Given a constant grip pressure, swing putting requires only one variable to make your putts roll varying distances: the length of your swing."

Charles, Bob (1989): "Some golfers make the same-length backstroke for every putt and vary the distance by changing the speed of the downstroke — stroking faster for a long putt, easier for a short one. That's a dangerous way to putt since it relies too much on precise feel and timing. I handle putts of different distances by varying the length of my backstroke and maintaining the same, smooth tempo."

Leadbetter, David (1997): "Whether you're stroking a three-foot putt or a 30-footer, virtually all good putters swing the putter with the same tempo. ... The longer the putt, the longer the stroke."

Nicklaus, Jack (1973): "I basically govern distance through the length of my backswing, trying to retain a constant pace and strength on all putts."

Stockton, Dave & Barkow, Al (1996): "On a purely technical basis, but one that derives from your feel and mindset, a soft roll is the product of the stroke having the same speed from backswing to impact to follow-through. On the longer putts you don't stroke faster and harder, you just make a longer stroke." [105-05]: "I am often asked if the length of the stroke correlates to the distance and speed of a putt. The answer is yes, though I tend not to think about the length of the stroke except on longer putts. If you are putting by feel and have seen the putt to the hole well before you stroke it and have incorporated into your system the idea of never going more than 16 inches past the hole, the length of the stroke will be appropriate. "

Every addition of backstroke length increases the putter head speed at impact in precise increments naturally on the basis of the involuntary action of gravity — not trying to time the downstroke with "muscle memory" or anything artificial. Because of this, for any given green speed, every exact distance

across level green will correspond to one and only one backstroke.

INSTINCTIVE TOUCH FOR EACH GREEN AND DISTANCE.

Distance control is understanding how the brain relies upon your tempo and acceleration pattern always being the same, plus recognition of green speed, to “target” the distance of the putt and hence establish the backstroke instinctively and completely without conscious involvement.

The brain, specifically the cerebellum, uses pre-established tempo and acceleration pattern, an appreciation of green speed, putter head heft, and ball hardness, to know what speed the putter head will have for every backstroke length. The brain then correlates the length along the ground to the target with the stroke that rolls the ball just that distance, using the tempo and stroke movement pattern. In simple terms, once you appreciate green speed (you already know your putter and the ball), and once your tempo and motion pattern is set, the only other thing you need for TOUCH is TARGETING. Hence, TOUCH equals TEMPO plus TARGETING.

TARGETING TEACHES THE BODY FOR ACTION.

The sense of TARGETING as used here is how the body (especially the head and neck) MOVES to build an appreciation for the distance from ball to target for purposes of the forthcoming well-tempoed stroke motion of rolling the ball that distance. It boils down to setting up beside the ball with the gaze straight out of the face and then turning the head-neck like a Ferris Wheel or Tilt-a-Whirl on a stable axis of turn and delivering the passive gaze straight along the ground as the neck turns a specific angle and pace as far along sideways as the target.

HEAD-NECK MOTION PRIMES SENSE OF DISTANCE.

The brain's sense of distance from ball to target across the green is a layered and cumulative sense that has peak intensity and clarity and is meaningful only in reference to an impending action, such as rolling the ball with a putter from its starting location across the surface as far as and not farther than the target location. In general, the brain knows from modest experience with golf courses that all greens fall within a certain basic range of sizes and shapes, so there are pre-existing known limits that help the sense of distance.



The angle the neck turns when you “face” a distance down the line is unique for that distance; every neck angle from a consistent setup corresponds to one and only one distance down the line. The brain uses the nerves in the neck to track this head-on-torso angle every day. (Berthoz, 1992).

Also, a person who has played a specific hole before already remembers the size and shape of the green as well as previous putts on this green. Similarly, rats know mazes with cheese at the far end and London taxi drivers know the streets and layout of the City in ways not available to others, and this difference is reflected in their brains, specifically in the hippocampus. (O’Keefe & Nadel, 1978). In the same manner, people learn the interior layout of their houses and can navigate quite well in complete darkness. So there is a “home course advantage” that involves the easier recognition of distances.

Then there is playing this hole and green in a specific round, planning the shot into the green from the approach distance, surveying the green as it sits in the general terrain, and observing the size and the shape of the green become known with increasing detail as the golfer walks into the green from the fairway.

Next comes the sense of distance from observing one's ball and associating its location, the pin location, and previous putts on this green. More distance information is gleaned from watching others moving about on the green and executing their putts. The sense of distance continues to cumulate and sharpen during one's routine for reading the putt and setting up to the putt. Finally, the "targeting" move of head, neck, and eyes from the rooted location beside the ball adds the final polish to the distance sense for rolling the ball from here to there with the usual putting stroke.

Hence, a sense of target location in reference to the ball and body in putting is a layering and sequencing of distance knowledge from disparate sources, and this knowledge comes together only in the context of the action of the specific putt. The brain's knowledge of the relationship between body-intending-action and the target is "embodied" knowledge, as opposed to some form of verbal or analytical representation in symbolic terms. ("It is what it is, whatever it is.") (Gallagher, 2006; Gibbs, 2005, Varela, Thompson, and Rosch, 1992).

AN INSTINCTIVE MOVE GENERATES BACKSTROKE SIZE.

Starting by looking straight out of the face (not down the cheeks) and positioning the face so that the gaze is directed down to the ball with the eyes either vertically above the ball or slightly inside (which doesn't matter much so long as the gaze is really straight out of the face), the neck ANGLE that results from turning the head to "face" the target corresponds

one-to-one with different distances along the ground. A short turn of the head “faces” a nearby spot down the line. A “long” turn of the head “faces” a more distant spot down the line. Every distance along the line corresponds to one and only one head-turn angle.

The PACE of the neck turn might as well be the pace that results from imagining your neck turn is making your still gaze follow an actual rolling ball in real time from the address position along the ground towards the target, slowing down and taking any break to the hole, and then toppling over the lip into the hole. This pacing of the neck turn adds to the sense of instinctive tempo for the stroke. The head then returns the face back along the same path to the ball at your feet, and the last section of every putt path straightens out coming back to the ball and your setup and putter face alignment, so the start line of the putt is always straight off the face.

Wait for the shine on the ball before pulling the trigger. Once the head and gaze returns to looking down at the ball (or a grass blade between the ball and putter), pause a moment as vision and balance reestablish their focus, then start the stroke. The inner ear balance / motion detection system includes a fluid that sloshes like a tide among the reeds to indicate head and eye attitude and head motion. (e.g., Haslwanter et al., 1996). Because the inner ear has just been in motion turning towards the target and back, the cerebellum’s coordination of vision, the body, balance, and space is temporarily vague until the inner ear motion has calmed back down. Looking down to the ball, the eyes will also have to adjust the lenses to focus on this new distance (closer than the target) by relaxing the ring or circle of muscles holding the lenses stretched thin and allowing the lenses by natural elasticity to fatten back out to the new focal range. This process takes about a full second for adults, so the



shine on the ball's cover will come into sharper focus while you are looking at the ball. Just wait in patient stillness as vision and balance reset themselves. This clears the mind and sets the pivot and eyes in a stable position for the stroke.

A "ONE POTATO ... TWO" TEMPO.

"You don't take the putter back slowly and accelerate through or vice versa. It is still a pendulum stroke. There's a beat to it and the beat doesn't change. It's one-two, one-two. Not onnne-two, onnne-two, or one-twooo, one-twooo." — Rodgers, Phil & Barkow, Al (1986). *Play Lower Handicap Golf* (South Norwalk, CT: Golf Digest, 1986) 93.

The brain will simply give you the backstroke length by your adhering to your tempo. Let the putter move as far back as it wants while you think "one potato" and don't deliberately get involved in "fixing" the backstroke length — especially by shortening it and stopping before all four syllables of "one potato" have gotten out and the putter coasts to its own stop at the top of the backstroke, wherever that ends up. Just stay out of your own way on this. The rest of the putt takes care of itself from here on in with your dropping naturally and then riding the putter down and up to a finish. It's always the same. "One potato" coasting to the top, then a transition "... " as the stroke drops down to impact, and then the lifting to finish the stroke right at the bottom on "two" or on "lift." Always the same.

The end result is that TOUCH is simply the TARGETING "look" that sets the backstroke length instinctively. Once the targeting look is done, just putt with a nice tempo.

TEMPO TIMING AND ACCURATE TIMING PERFORMANCE.

Simply thinking about the tempo is usually insufficient for accurate performance according to the tempo. Apparently, humans are not all that well synched up to the regularity of timing mechanisms like watches. This reveals itself in the general fuzziness with which people attempt to count silently to 60 and see how close they can come to the sweep of a second hand for 60 seconds. Most people end their counting no better than 10% off the sweep of the second hand. In the context of a two-second putting stroke period, that is a huge error in timing. Consequently, I recommend that golfers learn to observe their timing first (“it is what it is and none other”), and then learn to speak this exact timing pace in the way it naturally occurs.

Counting “one potato ... two” is not sufficient to hone stroke timing unless the pacing of the syllables matches the actual movement. The tendency of golfers is to short-circuit the back-stroke and not pay a lot of attention to whether the count was quickened slightly so as not to appear clipped. Rushing the syllables of the count out is just as bad as not completing all the syllables without any rushing. This tendency is even more pronounced when experienced golfers are asked to slow down to a more relaxed, casual tempo more in conformity with natural gravity timing. Gravity is generally slower and more gentle over short ranges than most people seem to appreciate. This causes most golfers difficulty in relaxing in tune with gravity.

Perhaps it is worthwhile rehearsing the history of expert golfers on timing. Walter Hagen, the first professional superstar golfer



of the 1920s, when asked to state the most important tip for excellent golf, responded: "Slow down and smell the roses." Hagen taught Bobby Locke, among others, and Locke's main tip was similarly, "Slow down. Never hurry." Locke was notorious for the imperturbable manner with which he sauntered down the fairway completely oblivious to the exasperation of other pros at the slow pace of his play. Locke of course taught Gary Player, who offered his favorite tip in words to the effect: "Drive slowly to the golf course, and do everything before the round in as slow and relaxed a manner as you can."

The timing of the brain as expressed in brain waves or in arousal level tends to persist over about a twenty-minute period. A short-order cook who just walks out of his restaurant after a long shift is not calm and relaxed, nor is a person who has driven thru rush-hour traffic, and neither will calm down to a more relaxed state for another 20 minutes or so. These sorts of influences affect the precision of timing on the course. The usual advice to seek out a steady demeanor and temperament during a round of golf has a lot to do with precision in overall timing and tempo.

As a method of sharpening up one's sense of tempo, one can simply swing a putter with relaxed strokes to nowhere in particular with the focus on learning to count like the putter swings. This immediate connection with the physical reality of gravity timing calls up the relaxed inner sense of timing. Another timing trick is to focus on perceiving the world as it is, looking at leaves or grass or water solely to take in the phenomenal aspects of the world as they really are in the here and now. (e.g., Lampert, 1998, at 93). This eliminates verbal thoughts of past and future and serves to calm the mind. Closing the eyes and focusing upon the pattern of calm breathing invokes alpha-wave timing in the brain, which also helps. In general, some form of immediate embodiment of the timing with the cardiovascular system seems to work best for vesting the golfer with timing precision in conformance with gravity

timing, and indeed with timing in general apart from tempo timing.

Two other ways to embody the timing are: whistle the timing according to the “bob white” whistle “whuuuuuuSWHIT!” and to think of the back-and-thru timing as similar to the breathing cycle of effortful inspiration followed by relaxing and non-effortful expiration. When these are matched to the actual stroke timing, they serve as non-verbal embodiments.

STRESS AND ANXIETY AS HARMING TIMING.

Stress and anxiety cause shallow breathing and an accelerated heart rate, which causes imbalance in the gas mixture in the blood of oxygen and carbon dioxide. (Grossman & Defares, 1985; Guyton, 1987). The cardiovascular system operating at an accelerated pace distorts the golfer’s sense of objective timing and increases muscle tension and narrows vision deleteriously. (e.g., Friedman et al., 1984; Jacobson, 1938; Watson, 1987; Williams, 1991). The “autogenic” techniques to reduce or control stress include deep breathing and some form of muscle relaxation.

Relaxation breathing, or “abdominal deep breathing”, has deep roots in Buddhist meditation going back about two thousand years. (Fine, 2003; Mangum, 2004). Golfers have been using these techniques to overcome stress and anxiety for decades. (e.g., Dishman, 1983; Lampert, 1998; Meacci, 1986; Smith & Dawson, 1961).

Deep breathing restores cardiovascular control and calms the heart rate. (Schwartz, 1987). This deep breathing for putting typically occurs while the golfer is waiting turn or is in various stages of the routine. Breathing patterns also are used in the stroke itself for body control. Jack Nicklaus, for example, breathes and then holds the breath before starting the stroke as a means to eliminate diaphragm movement as a source of potential stroke inaccuracy. “I hold my breath during and just

prior to making the stroke. By preventing the diaphragm from moving, this helps me to keep my body and head perfectly still." (Nicklaus, 1972).

Muscle relaxation on the green takes the form of either "progressive relaxation" or a more specific relaxation of the shoulders, arms, or hands. Progressive relaxation is a whole-body technique from Edmund Jacobson in the 1930s (Jacobson, 1938). Closely related is the "relaxation response" of Herbert Benson (Benson, 1975). One form is to squeeze and then relax the grip on the handle to relieve stress and tension in the hands, to magnify feel in the fingers, and to establish and maintain a constant grip pressure throughout the stroke. "It's a good idea (and if you watch the pros you'll see they all do it) to squeeze and untighten your grip a few times before you stroke the putt. This increases your "feel" and prevents you from changing your pressure." (Smith, 1972, 58). Shaking the tension out of the arms and shoulders is standard technique used by Loren Roberts, Tom Watson, and many others. (Foston, 1992, 134; Watson, 1987). Other golfers use some form of putter motion before initiating the stroke, to relax the muscles, such as placing the putter in front of the ball and then moving it behind, or bouncing / tapping the putter behind the ball in a count before starting the stroke. (See Middlecoff, 1960). Nicklaus and others teach "unweighting" or "hovering" the sole of the putter off the ground and onto the tops of the grass blades as a means to smooth out and relax the takeaway. (Nicklaus, 1989). All of these techniques tend to promote the usual precise timing that stress threatens.

TARGETING "LOADS" THE IMPACT FORCE.

Once calibrated to the green speed, and familiar with the putter, ball, and tempo, the golfer's touch at the last comes down to targeting. The targeting is used by the instincts to assess exactly what force the ball, putter, and green speed will require to roll as far as (and not long or short of) the target distance. Then the instincts "look up" the non-conscious association be-

tween force at impact and one and only one backstroke size. Then the instincts load the backstroke "cannon" with just the right ballistic black powder for the backstroke to take off from the ball and catch up with the internal, on-going swings the instincts know so well. The instinctive brain works backwards from the known to the needed, sorting first the distance, then the impact force, then the backstroke size, then the backstroke movement force that generates the correct size in light of the usual tempo. (See Foster & Wilson, 2006).

At the end of this process, a backstroke size results. This backstroke size is determined by the instincts in light of the downstroke timing that will generate the impact force intended. NO OTHER DOWNSTROKE TIMING IS ACCEPTABLE TO THIS INSTINCTIVE PROCESS. Any speeding up results in the ball rolling long; any slowing down results in the ball stopping short. In other words, the size of the backstroke is always exactly right, so the golfer needs to learn to accept this consciously and stop adding or subtracting to the motion pattern of the natural downstroke. An instinctive backstroke is always the right backstroke, or else the adult has a problem in normal life.

CORRECT TOUCH IS "NOT LONG" AND "NOT SHORT".

Perfect distance control requires that the golfer not roll the ball too long and not roll the ball too short. In order to perform this, the golfer needs to understand the relationship of the timing back and then the timing down.

The reason a golfer rolls the ball too long is due to conscious fear of being short. This fearful golfer does not know the timing relationship back and thru, and is simply coming up with a downstroke speed that is a guess against being short. This speed is usually too long.

However, because the instinctive brain of the normal adult never generates a backstroke that is too long (as this would disable the movements as in “dysmetria” that is a sign of cerebellar damage), IT IS NOT PHYSICALLY POSSIBLE FOR THE GOLFER ATTUNED TO THE FIVE FACTORS TO ROLL THE BALL FARTHER THAN THE TARGET WITH A NOT-TOO-LONG BACKSTROKE UNLESS THE GOLFER SPEEDS UP THE DOWNSTROKE. So, a golfer who resolves never to speed the usual downstroke has eliminated one half of the problem of perfect touch and has no rational basis to fear going long from an instinctive backstroke.

The second half — rolling the ball short of the target — is the greater, more troublesome issue, but is fixable. The reason golfers are short is because they fear going long.

A golfer who knows that it is not physically possible to go long when the downstroke timing is never sped up no longer has a basis to fear going long, and so should also never be short. Alas, the rational mind seldom trumps emotional habits and deep-seated attitudes. And the “fear of going long” nevertheless manifests itself in two ways: 1) the golfer’s conscious mind reacts fearfully to the larger, more casual gravity backstroke and stops the backstroke early in the usual timing and short of the full instinctive size — the resulting “load” of the backstroke position is then insufficient to generate enough force at impact to roll the ball all the way to the target, and the putt is short; and 2) even if the golfer allows the more fulsome backstroke to attain its instinctive amplitude, at that point in time the golfer reacts out of fear that the large backstroke will roll the ball too far and decelerates the downstroke by tensing up in an effort of the conscious mind to “control” the situation, and this tense stroke impacts the ball with a velocity and force that is less than the velocity and force of a relaxed, free-falling swing, so the ball stops well short.

In all three cases, going long and the two forms of going short, the golfer's conscious mind reacts to fear out of ignorance of how the instincts actually work to adapt to reality and avoid these problems in everyday movements such as opening a door or reaching and taking up a glass of water from a table. And in all three cases, what gets changed in a bad way by the fearful reaction is the timing of the stroke. The cure in all three cases is the same: stick to the timing back, and stick to the timing down.

"A common fault in long putting is failure to take enough backswing. Many golfers will take the same length backswing for a long putt that they do for a short one, and try to hit it harder, often with disastrous results. "The more aggressively you strike the ball, the more difficult it is to time the stroke," says Bob Toski. "And every stroke in golf has to be timed, whether it's a putt or a drive." If you are having trouble with erratic long putting, check to see that you are not cutting your backswing. Middlecoff recommends taking a couple of exaggeratedly long practice swings to restore the feeling of a full enough stroke." — Dennis, Larry and Golf Digest Professional Teaching Panel & Advisor Staff (1975). Art of putting: part 2: judging distance, *Golf Dig.*, 26(11), Nov 1975, 76-79.

If the golfer allows gravity to handle the timing down, gravity will gladly do so and will never vary. The only variable is the human intervention or interference with the gravity timing due to conscious efforts to control the stroke timing and forces. If the golfer at the top of the backstroke simply keeps the shoulders, arms, hands, and putter in a unified shape with some modest muscle tone and then "rides the putter down as it naturally and freely swings," the timing will always be the same and will never get hurried. No putts ever run long. In the backstroke timing, from address to top of backstroke, sticking to the timing means that while the stroke is underway, the golfer does not curtail the stroke due to conscious reaction to its size but instead allows the stroke to attain whatever size the instincts are generating in their non-conscious manner. Allowing the backstroke to fulfill its destiny, as it were, is the same as allowing the backstroke's full timing to transpire from

start to coasting stop. The backstroke does not come to a halt before the usual timing has elapsed.

In short, learn a timing back and a timing down, commit this to the good graces of the non-conscious instincts, and then get out of the way and make a stroke that is well-timed and smooth and forget the size of the stroke that happens and don't worry about the distance of roll that is about to occur. Just witness what the brain does when you stick to the timing.

A phrase that helps this process is: "*Let it grow, let it go.*" That is, allow the backstroke to reach its full potential without any conscious expectation or rule or fear or judgment about the size that happens instinctively, and then allow the free-swinging downstroke to transpire on its own accord without slowing it or speeding it up or judging whether its pace is too swift or too slow or fearing whether the roll will be short or long.

ENOUGH BACKSTROKE.

Consistent with the "let it grow" prong of an instinctive backstroke, the fearful golfer will often make too short of a backstroke and revert to the "hit" approach to distance control. No instinctive backstroke is ever "big enough" until any trace of impulse of "hitting" at the ball in the forward stroke completely dissipates as the putter head coasts to the top of the instinctive backstroke. Until the golfer experiences this "patience" in lieu of anxiety or a need to control the stroke, he or she has not fully tapped into the authority and power of the instincts.

NEVER HURRIED, NEVER WORRIED.

The mantra of the great putter is "*Never hurried, never worried.*" That attitude follows from the implicit knowledge gained over long experience that the casual, full backstroke is ALWAYS SUFFICIENTLY LOADED to roll the ball all the way to the hole and therefore any "hurry" in the downstroke is only going to make the putt run long. The unhurried golfer does not

fear being short. The natural, casual backstroke is always fully and correctly loaded for the total distance, without any conscious concern or attention.

Nor does this golfer fear going long or tense up and curtail the backstroke or slow the downstroke. This golfer knows by experience that only speeding up the downstroke sends the ball long — and going long is never due to an instinctive, natural backstroke that is too large. This golfer also knows that tensing up is what causes the ball to stop short, and that free-flowing strokes roll the ball farther along.

In the 1950s, many if not most professional golfers lived by the rule: “Let the putter head do the work.” This is fundamentally a casual style of putting that is more closely attuned to the relaxed timing of gravity in putting than most golfers today. This 1950s style had another, perhaps more important formulation: “The only backstroke that is full enough to allow the putter head to do the work is one that is big enough to eliminate any vestige of conscious impulse that something must be done to avoid going short.” The backstroke is KNOWN to be correctly sized only when that conscious impulse to “do something” in the downstroke other than to let the putter head do the work has completely dissipated.

THE ALTERNATIVES AIN'T PRETTY.

The alternative to instinctive distance control is either emotion-ruled timing or timing that is formulated according to abstract, conscious rules. Emotional putting is usually justified by the half-baked notions that “putting is all feel”, “putting is purely individual,” and “putting is artistry not mechanics.” This approach CAN work in an unmindful fashion but only so long as the collection of supporting conscious notions keep the conscious mind out of the process AND so long as the timing back and thru is stable. Unfortunately, emotion-based putting more often ends up changing the timing, especially in the downstroke. A typical case is what happens when the backstroke is

shortened artificially. (Actually designed as a bandaid for poor line control due to namby-pamby-ism in the stroke, sometimes instructors claim this gimmick helps make sure the ball gets past the hole under the constantly repeated saw “Never up, never in”.) This gimmick short-circuits the instinctive process in the middle of making the stroke match up to the internal model of the on-going back-and-thru stroke, and throws full responsibility suddenly and unexpectedly onto the conscious mind, which predictably reacts emotionally, as there is no rational plan for how to get out of the predicament. The conscious mind knows the backstroke is shorter than was planned, so a hasty acceleration forward of some kind is required. The golfer then shoots the forward stroke faster than usual, but without any way to gauge how fast is the right fast. Touch duly suffers.

The conscious rules for touch include the teaching that “one inch of backstroke equals one foot of roll.” Well, it doesn’t, unless the ball, the putter, the green speed, and the tempo all cooperate. Other abstract rules have the same basic difficulty. Touch is never abstract and is always simply one golfer with his or her putter, ball, tempo, and sense of target on a specific green here and now. “It is what it is, whatever it is.”

UPHILL / DOWNHILL EFFECTS.

Touch is affected by uphill and downhill changes from start to finish of putts because the change in elevation of the ball requires addition or expenditure of energy. A level 20-foot putt requires all the usual energy to roll across the green 20 feet, but an uphill putt for which the ball ends up one foot higher than it began requires all of this level energy PLUS some more. The extra is the energy required to move your golf ball one foot higher

“Yeah, after each of my downhill putts.”
— Homero Blancas, asked if he had any uphill putts.

“If I’m breathing heavy while walking on a green, I’m going uphill. If I trip, I’m going downhill.” — Spec Goldman

against gravity. And for downhill putts, the elevation drop gives the ball extra energy so the golfer needs to deduct something from the usual "level" energy. What does that mean?

There are several different ways to approach this. The easiest and simplest way is to adjust the factor of "green speed appreciation" in an intuitive process. The "know-how" for this intuitive solution seems to require a conscious prompting along the simple lines: "uphill is slower, so putt the ball more aggressively all the way to the hole without being short" and "downhill is faster, so putt the ball more carefully only so far as the hole without going long." With that conscious prompting, the intuition kicks in and feeds the instinctive stroke just the right amount of adjustment in what is an effective sense of green speed for the putt. (See Anderson, 2007).

Admittedly, the green speed per se is not different simply due to the fact that the surface slopes uphill or downhill. Surface is surface, with the same friction properties in the grass. Still, the "weight" of the ball on the grass does depend somewhat on the slope, and a ball rolling on a steep slope does not experience as much friction as a ball rolling on level grass experiences. But the difference in friction is apparently not often big enough to register significantly. In the end, the adjustment in the appreciation of green speed for uphill or downhill putts is no more than a useful fiction.

Two other approaches are more analytical and conscious. The first uses the Stimpmeter reading to convert elevation change to level footage of putting to add or subtract. Because a Stimpmeter releases a ball from about one foot in elevation in order to give all balls the same specific velocity at the bottom of the ramp, whatever the "Stimp reading" for that green that day is the basic unit of level footage that goes along with each foot of elevation change. Hence, on a "Stimp 10" green, an uphill putt of 30 linear feet that also has two feet of elevation change requires an extra two units of Stimp ($2 \times 10'$) to be added to

the linear distance; the golfer then looks at the 30-foot uphill putt as if it is the same as a 50-foot level putt. But in this case, the golfer does NOT think “uphill is slower” but instead uses the same sense of green speed obtained from the core putt across level surface. Otherwise, the golfer will get double-crossed and roll the ball well past the hole. Going downhill, the golfer would subtract 20 feet and putt the ball at a target merely 10 feet away, relying upon the slope’s dropping two feet to supply the difference. Again, though, the golfer does not in this instance think “downhill is faster,” since this will cause the ball to stop far short of the hole.

An even trickier method is to use the formula: $\text{Stimp (in feet)} \times \text{Slope (in percentage)} = \text{Percentage of Total Linear Feet of the Putt to add or subtract}$. Hence, a 50-foot uphill putt that rises 1 foot in elevation on a Stimp-10 green has a Slope percentage of 2% or 2 feet rise for every 100 feet of run. The formula then suggests adding $10 \times 2\% = 20\%$ to the 50-foot putt, so that is an extra 10 feet. The golfer then looks at the uphill putt as the equivalent of a 60-foot putt across level green with the usual green speed in mind.

SPECIAL CASE OF SLICK DOWNHILL PUTTS.

Downhill putts combine green speed with slope. That combination results in three separate categories of downhill putts: 1) putts where the golfer has the potential of stopping the ball at the hole with the usual-tempo stroke; 2) putts where the golfer has a gut feeling that doubts the usual-tempo stroke will be careful enough so that the ball is likely to run well past the hole; and 3) putts where the golfer does not have the potential of stopping the ball at the hole because the combination of green speed and slope is too severe for any ball rolling downhill to stop. The special case is the middle one. For the last case, the golfer simply starts the ball sideways to whatever degree will “feed” the ball onto the fall-line that runs thru the cup downhill with the minimal speed possible and hopes the

hole gets in the way. For the first case, the golfer uses the normal stroke, possibly adjusted as discussed above.

In the special case, the golfer has thought already “downhill is faster”, but this is still not careful enough and the golfer feels this in his or her “gut instincts.” Adjusting the sense or appreciation of green speed (among the five factors) has not alone been sufficient. Nor has the adjustment of the target by thinking of rolling the ball short of the hole. Accordingly, the only remaining factor available for adjustment is tempo. Ordinarily, adjusting the tempo is not a good idea, but these are desperate circumstances.

An effective adjustment of the tempo that leaves the size of the backstroke to the instinctive processes is one I call “even, even.” Instead of the freely swinging “one potato ... two” usual tempo, now the golfer plans to use a slo-mo, mechanical, steady velocity / non-accelerating stroke motion that has utter size symmetry back and then thru. This tempo has five timing sections: from start to halfway back “Eve...”; from halfway back to top of backstroke “...en”; from top of backstroke to impact “...”; from impact to halfway to follow-thru “Eve...”; from halfway to top of follow-thru “...en”. Two syllables fill the backstroke, a silence corresponds to the stroke down to impact, and then the same two syllables fill the follow-thru, all in a steady slow-motion movement. This conscious plan to switch from the usual tempo to the more deliberately controlled “even, even” stroke timing brings the instinctive setting of the backstroke back online without trepidation. Look and putt.

SPECIAL CASE OF STEEP TIERS.

Usually, tiers on greens leading from one lobe up or down to a second lobe are fairly steep, and balls toppled over the top edge will not stop on the tier slope itself but will roll off the bottom edge of the tier and continue across the less sloped, usual green surface for some distance. The key to putting for distance control downhill over one of these tiers is the esti-

mation of how far past the bottom edge the tier's elevation drop will send the ball.

If the tier itself will send the ball beyond the target distance (hole), then all the golfer can do is topple the ball gently over the top edge of the tier and let nature take its course. But if the ball's off-roll would stop short of the target distance, then the golfer's job is to deliver the ball over the top edge with topple-over speed plus the difference of from where the ball will stop to the target.



Tier Down Back to Front
4' Drop on Gentle Slope

For example, if a ball is located 12 feet away from the top edge of a tier, and would stop eight feet short of the hole once clear of the bottom edge, the golfer faces two putts for distance at once: an initial 12-foot putt to topple over the edge plus an additional 8-foot putt the remainder of the way.

The “know-how” for this comes from a) good visualization of how far past the bottom the ball is likely to roll; plus b) combining the two distinct senses of distance with one stroke. For the latter, the golfer's intuition again comes to the rescue. If the golfer makes two practice strokes, one for the 8-foot putt and then a second, larger stroke for the 12-foot, the intuition will then accurately combine the two simply with the idea that the real stroke is “bigger than the last practice stroke”, with the precise details committed to the intuition. Then just stick to the tempo and pull the trigger with the biggest stroke of the three.

Going uphill over a tier, regardless of the elevation change or steepness of the tier, requires a two-phase distance calibration also. The first and most important sense of distance is what is required to get the ball safely perched on the top edge of the tier, without rolling back. The second distance is from there the rest of the way to the hole. Practicing the two strokes with the larger of the two second, the golfer again trusts the intuition to size the third, real stroke appropriately and sticks to the usual tempo. The sticking point that golfers usually need to gain more experience with is not underestimating how much extra energy is required to get the ball safely perched on the top edge of the tier. Because tiers often come with elevation changes in the 2-foot range, a typical Stimp-10 green requires an extra 20-feet of level putt distance simply to climb the tier. If the top edge of the tier is 12 feet away from the ball at address, then perching the ball safely on the top edge takes no less than the energy of a 32-foot stroke across level green. This is 2.75 times longer than the visual appearance of the distance to the top edge. The eyes don't help much in handling tiers.

SPECIAL TRICKS FOR LONG LAGS.

The main trick for successful long lags is an attitude of acceptance of the reality that few long lags will sink. While the golfer certainly hopes and intends to sink the long lag, he has a double-mindedness about the putt: he also wants to take the approach to the putt that makes any leave minimal (as in the phrase "tap-in for par"). For a golfer with optimal delivery speed for touch, there really is no conflict between the "make it" and "play safe" attitudes.

This dual-mindedness translates into "high and slow": always intend to sink, finish, or miss on the high side, with misses leaving the ball as close to the cup as possible. Good leaves after a long lag, in order of preference, are: first, high and slow, next to the cup on the high side; second, slow and too high, hole high but too high; third, high but not slow, just beyond the hole on the high side; and fourth, high but too slow, just

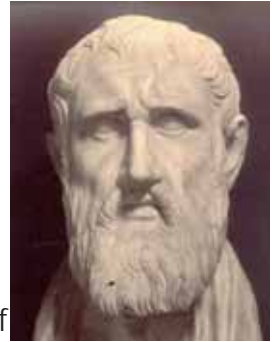
short but tracking on the high side. Bad leaves are: fifth, hole high but low side; sixth, too low but slow, hole high but lower; seventh, slightly low but long; and eighth, low and short. (Of course, you can still do worse than this.) In all of these leaves, “slow” takes priority over “high”, as distance is more important than line.

A technique used by Loren Roberts and Ben Crenshaw for lags is to get the distance right and then aim high-side just the right amount or perhaps a little extra just for insurance. This technique is about the same as one I teach called “intuitive reading”. Intuitive reading does not use a specific target spot near the hole, and instead uses the baseline and the fall-line for determining how high to aim and how far to putt once aimed. The golfer first divides the world into high and low with a direct line from ball to hole (the “baseline”), and then notes the orientation of the fall-line thru the cup. With reference to these two definers of the space, he then applies three rules: 1) never allow the ball to trickle low-side across the baseline between the start and the cup, but keep the ball on the high side all the way to the hole; 2) putt all the way to but not through the fall-line; and 3) aim higher and higher up from the baseline until sensing intuitively that a putt as far as the fall line cannot possibly trickle low-side, and stop aiming any higher as soon as possible but never too soon. This approach produces a “high and slow” lag that will have a high probability of sinking or at worst leaving a “tap-in for par”. The frequency of sinks

“For me, the distance of a putt has always been a bigger problem than the line of it. In the late 50’s, the late Jack Burke gave me a suggestion that has helped me considerably, however. On putts 15 feet or longer he advised me to visualize the putt as being half the actual distance, take a practice stroke at what I would judge to be that distance, and then hit the actual putt twice as hard as I had practiced. While this method may seem to be the long way round, it has nevertheless proved to be a surer method of judging distance.” — Art Wall, in *Golf Magazine* (1973). *Golf Magazine’s Handbook of Putting* (New York: Harper & Row, 1973; London: Pelham, 1975), 104.

depends upon the strength of the intuitive “gut feeling” that the aim is “high enough” and the courage to stop aiming higher as soon as possible. In large measure, this courage comes only with good distance control for rolling the ball all the way to but not thru the fall-line on a consistent basis.

Another technique I call “Zeno’s Lag Ladder.” Zeno the Greek philosopher used the paradox of walking halfway to the wall over and over to show the impossibility of ever reaching the wall. For lag putting, I teach dividing the long putt in half for the first practice stroke as if putting only halfway to the cup, followed by a second practice putt that divides the remaining half



in two, so the second practice putt is to a point three-fourths the way to the cup. The real stroke, then, is one that is bigger than the second practice stroke by exactly the same increment the second practice stroke was larger than the first practice stroke — that is, add another quarter-distance stroke to the second, three-fourths practice stroke. The golfer really has to think only: make the real stroke “larger” than the second practice stroke, and leave the details to the instincts to get the additional size just right.

A third special technique is to visualize a series of putts tracking to the hole, with the first visualization stopping well short 5-10 feet, the second visualization tracking on the same path and going halfway closer to the cup, and the third visualization tracking again on the same path, and this time rolling all the way to and into the cup. This series of visualizations narrows the problem of the lag down to getting the ball all the way to the cup without going long, and assists that process by focusing on the space and the roll of the ball thru that space nearest the hole. One of the main failings of golfers in lag putting is lack of clear focus on the space as far as the hole, with the perceptions vaguely attending to the vast in between space

or the broadly focused space near and past the hole. By visualizing as described, the exact and clear focus on the grass right near the hole that the ball is intended to roll over on its way into the cup sharpens up the sense of distance and the specific space the ball needs to traverse with appropriate end-of-putt velocity.

DELICATE STROKES.

Conventional golf lore frequently suggests use of a soft or deadened stroke with the toe end of the putter in order to handle slick downhill putts. This is thought to reduce the mass behind the blow and thus “soften” the “send”. Actually, softening the grip pressure would do more to soften the blow than shifting the point of impact towards the toe, but in either case this adjusts the factor of the “putter” itself. Personally, I think this causes other factor disturbances that serve only to fog up the distance control without a genuine benefit.

SHORT-PUTT TOUCH.

The gravity-based stroke is longer than most golfers are used to (because gravity is casual). But there is a limit. Short putts can feel awkward when trying to use the slow tempo. Apparently, a certain minimal stroke size is required to engage the body structure with a gravity stroke (just to or past the rear foot), and this stroke is sometimes overkill. This statement from the Golf Magazine Handbook of Putting neatly summarizes the problem of what the “feel” requires for a gravity stroke:

“On the longer putts you can feel the centrifugal force in your fingers, so that you have something definite to tell you that the swing is smooth. But if you use the long putt stroke on these short putts, you will find there is little centrifugal force to feel. This is the reason that so many short putts are wrenched or jerked off line. You get too anxious because you can’t feel the club head. It becomes

obvious that you should develop a putting stroke that will enable you to hit the short putts without getting a wrench or jerk into the action.”

(Golf Magazine, 1973).

In the shoulder stroke, the absence of “feel” is located in the muscles that generate the shoulder action, which are those of the abdomen and lower back connecting the upper torso to the pelvis and lower torso, rather than “feel” as usually thought of in the hands and fingers. But the basic point is true enough — unless the stroke reaches a minimum amplitude, the body does not sufficiently engage with gravity by stretching and contracting in a way that feels adequate and comfortable, with the result that the golfer experiences doubt and anxiety about the stroke. The “cure” for this is to adopt the rule of thumb that for any putt shorter than the distance one’s basic “core putt” rolls the ball is inside this minimal backstroke size, and whenever that is the case, simply forget about touch and focus instead on putting straight, as at this range distance is not a concern so long as the golfer’s stroke remains “smooth.” What is mostly required is avoiding “babying” the putt or jabbing the putt, as both are not “smooth” strokes and both wreak havoc with line and break on short putts.

From two feet and in, there is only very rarely a green slope and speed that requires anything other than simply aiming a smidgen to the high side of center and rolling the ball in the hole. On these putts, there is not enough time for break to grow large enough to affect the outcome, so just putt without worry. From three feet and out, however, is an entirely different matter, and casualness here for read or aim or touch inevitably proves costly. Generally, the idea of taking break out of the putt, closely examined, makes sense only for putts between about 3 and 6 feet, and only then when the ball starts around 8 or 4 o’clock with modest break uphill, as the other uphill putts don’t have enough break to worry about, and sidehill

and downhill putts are too risky for adding speed from this distance, with the hole's rim tilted downhill and the odds of a long comeback too high. Other than these uphill putts, adding speed to "take some break out" is not unduly risky only when the slope is mild and the break modest.

SUMMARY OF TOUCH

Of the five factors that determine one's ability to roll a ball a specific distance across the green so it stops where intended — ball, putter, green speed (including uphill / downhill effects), tempo and targeting — the instinctive golfer is simply "used to" the first four so that instinctive distance control always comes down to targeting and then making the stroke with the usual tempo back and thru. In special cases, the golfer will want to adjust the sense of "green speed" obtained with reference to level green by using the core putt; or might want to adjust the reference target distance; or might want to adjust the tempo itself in rare cases.

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Chapter 5: Straight Strokes.

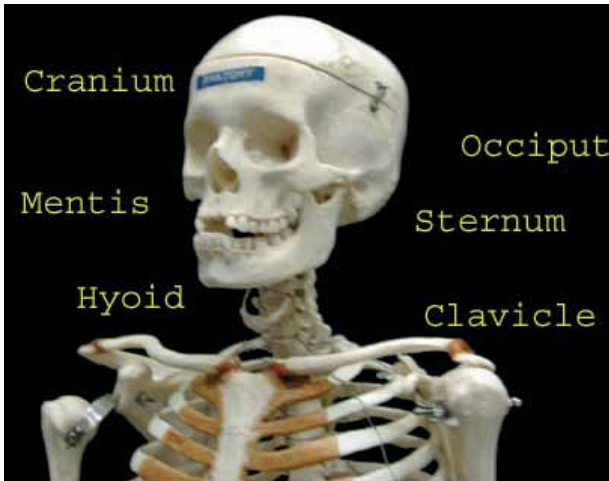
SKILL 3: PUTTING STRAIGHT EVERY TIME.

The setup is probably 75% or more of what matters in whether the stroke heads the ball straight sideways out of a conventional address position. The setup makes the appropriate stroke motion stable and repeating and accurate and natural. Having worked out TEMPO and TOUCH with TARGETING and instincts, you need to putt straight every time the same so the ball always goes straight away from the square putter face and exits the setup exactly the same way every time. Wherever the face is "aimed" thru the ball's center, that is how you have to set up the feet and shoulders, hands and eyes so that your ensuing stroke rolls the ball straight down the line of aim of the putter face. Because of the inverted order of presentation of the four skills, "setup" is discussed in the following section for "aiming the putter and the body." Presently, the discussion turns to the stroke motion, with limited discussion of the procedure for setting up to the aimed putter face.

A WORD ABOUT BIOMECHANICS & ROBOTS.

A human is not a robot. A "putting robot", whether "Perfy" or "The Rack" or "Iron Archie" or some other version, essentially has only one moving part: a shoulder frame in the center of which is a doughnut hole slotted onto a pipe, like a heavy plank with a hole drilled in the middle fitted onto a peg-like axle. All other aspects of the robot are rigidly fixed and unchanging. The only variable for such robotic motions is the angle the pipe makes relative to the surface, as the shoulder assembly is constrained by the column of the pipe to rotate perpendicularly or orthogonally to the axis of the pipe. A horizontal pipe (i.e., parallel to the surface) produces a shoulder

frame motion in a vertical plane and the fixed shape of the “triangle” translates this motion in turn to produce a putter head motion straight back and straight thru in another vertical plane. An up-tilted pipe produces a shoulder frame motion in a plane that is tilted top-back from the vertical plane at the same angle the pipe tilts up from horizontal, and this in turn generates a putter head motion in a parallel tilted plane in which the putter stays square to the plane as it rises up the plane on either side of the bottom of the stroke. A down-tilted pipe orientation produces a shoulder frame action on a plane that tilts top-away from the golfer-robot, generating a putter motion on a parallel plane in which the putter stays square to the plane as it rises on either side of the bottom of the stroke. In all these “putting robots”, the arms and hands remain in a set relation to the shoulder frame and have no motion apart from the action of the shoulder frame.



In a human, however, the shoulder frame is not fixed in relation to the neck or the cervical spine. There is no skeletal bone connecting the shoulder assembly and the spine, and the only bones connecting the

shoulders to the rest of the skeleton are the clavicle bones that meet at the top of the sternum, at the sterno-clavicular joint with a rotational motion like a door knob. (Allard et al., 1995; Behnke, 2006). Even if the neck is set parallel to the surface, this in itself does not preclude shoulder frame motion in some plane other than vertical or a plane tilted other than

orthogonally to the neck; and by the same token, setting the neck at some angle other than parallel to the surface does not preclude moving the shoulder frame in a vertical plane or a plane tilted other than orthogonally to the neck. Nor need the shoulder frame be the only moving part: the arms and hands are not necessarily set in relation to the shoulder frame, unless the golfer uses a base muscle tone to establish the form of the "triangle" and maintains this form throughout the stroke. The arms and hands otherwise retain the capacity for independent motion. And another major difference is that in a robot some independent person or agency starts the stroke, whereas the human starts the stroke by recruiting certain muscle patterns in the musculoskeletal structure to move one or more body parts in a manner that creates reciprocating reaction elsewhere in the body in a balancing of the body in motion. A robot is so constructed on a stable base that any reciprocating movement in the base is effectively subdued by the mass and structure of the base and its being bolted or otherwise planted firmly on the surface.

The failure to observe these differences leads many people to teach "robotic rules" for setup and stroke action that, frankly, are not "natural" human postures or movements in any sense. Indeed, the failure to comprehend the basic one rule concerning robotic movement leads others to teach that "hand position in relation to shoulders" determines stroke path, when in fact the position of the hands is irrelevant in robotic motion and only partially relevant due to torques introduced by positioning the arms and hands out of gravity. And moreover, the hands do not naturally hang in line with the shoulders in a forward-bending address posture, but over the toes, while the elbows fall directly in line with the shoulders and gravity and the balls of the feet. Thus, positioning the hands directly beneath the shoulders when bent forward at address in fact positions the hands inside the line of gravity, creating a torque outward from the body during the stroke. Related teachings based upon a robotic model of the stroke include "the head

must not move” and “the lower torso must not move”, both of which ignore the reciprocating and balancing reaction of the human body in motion.

A NATURAL HANGING OF THE ARMS AND HANDS.

An instinctive stroke motion stays with the “usual” or “natural” pattern of motion, rather than an artificially devised set of postural controls promoting subsidiary goals not necessarily required or even effective for achieving the overriding goal of stroking the ball straight with good touch. In this section, the focus is kept solely on achieving the main goal: choosing postures and motions that role the ball straight with good touch with the least departure from “natural” movement patterns allowable.

The natural and in my view optimal setup posture of shoulders, arms, and hands is a natural “hanging” of the arms and hands in gravity. This positions the shoulders directly above the balls of the feet to catch the bent-forward weight. The elbows then hang in the plumb line from shoulder sockets to balls of feet. The hands, however, due to the development over time of muscles that maintain a slight angle at the elbows, naturally hang directly above the toes for most people. Here are a few examples of the natural hanging of the arms and hands:



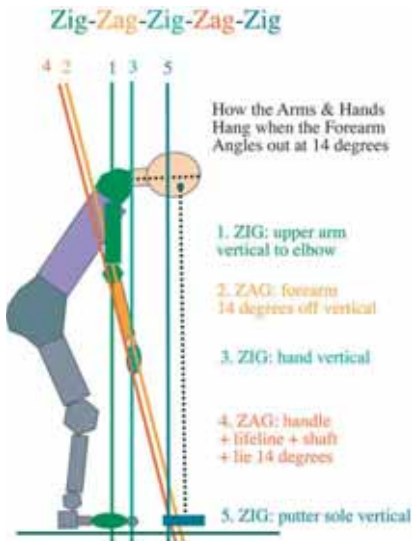


This setup is as tension-free as it gets, because the arms and hands are not fighting against gravity to hold a position out of plumb. While the weight of the hands and forearms opposes the developmental tension holding the elbow angle, tending to straighten the angle slightly, and while the offsetting of the hands out of gravity tends to make the elbow swing a bit closer in towards the ribs out of exact plumb from shoulders to balls of feet, the overall effect is very minor and indeed heightens the sense of forearms and wrists and hands with a slight increase in stretch-downward sensation in muscles and tendons.

Another aspect to this natural setup is the relationship between the natural hang of the forearms, the shaft or lie angle of a properly fitted putter, and the lifeline in the palms of the hands. Because the angle of the forearm is more or less permanent, the hands at the ends of the forearms hang back into gravity along the axis from base of hands to tips of fingers when a person simply stands in a relaxed manner. The angle down of the palm (plumb to gravity) in relation to the axis of the forearm and the angle of the forearm to the plumb line of upper arm from shoulder to elbow are necessarily the SAME (or very nearly the same) angle. If one stood to the side of a person standing erect and photographed their silhouette, the angle at the elbow would match the angle from forearm to axis of palm. The axis of the palm when the hand extends straight off the forearm is replaced by the "lifeline" at the base of the

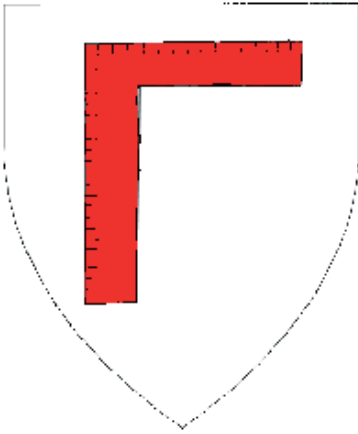
thumb pad when the hand hangs down off the end of the forearm, since gravity makes this wrinkle on the palm by its folding the weight of the thumb pad billowing down towards the axis of the palm. So the lifeline itself matches the axis of the forearm, when the arms and hands hang naturally. If the putter is fit to the golfer so that the lie angle of the putter flatly soled to the surface presents the handle to the naturally hanging hands and so that the edge of the handle meshes to the lifeline, this also matches the axis of the shaft to the axis of the forearm.

The overall pattern described is:



CARPENTER'S SQUARE OFF THE FOOT.

A consistent stroke requires a consistent setup. Biomechanically, the stroke will tend to follow the alignment of the shoulders. Consequently, the preferred setup features shoulders aligned parallel to the target line, and the target line is established by the aim of the putter face.



Everything about the setup builds off the putter face orientation to get the body set for a straight stroke that rolls the ball that way. In a comfortable stance, a short line out from the lead big toe will intersect the target line square out of the putter face a few inches past the ball's center and form an inverted "L" shape intersection. Every ball MUST roll over the corner spot of this "L" intersection, or the putt is not

straight away from the face. This spot and "L" shape is always exactly the same because your setup distance from feet to putt line is always the same (about two putter heads, and fixed by the distance from your shoulder socket to your pupils, about 8-10 inches for everyone) and the width of your stance for balance is always about the same as the width of your shoulders. Happy feet give you the "all-clear" signal that the body is ready to make a stroke that will roll the ball over the "L" point. This Carpenter's Square "L" point is about 3-5 inches ahead of the leading equator of the ball, opposite the toe. When looking down at the ball, your universe at the time of pulling the trigger at the start of the putt consists solely of this constant visual arrangement of just what you see at your feet, and this look is ALWAYS exactly the same. You can see exactly where the ball must roll over the intersection of the Carpenter's Square and this helps sort out the feelings in your shoulders and feet so that the actual stroke movement does what it needs to do for a straight putt. The upshot of this step is that, wherever the face is aimed, a straight stroke builds from setting up square to the PUTTER FACE, and not square to the TARGET. That is, however the face is aimed behind the ball, there is one and only one direction square thru the ball, and that is the direction you must set up square to, even if the aim is wrong.

STRAIGHT STROKE MOVEMENT.

Once you are square to the face's only aim and putt line, and have taken your head-turn look to gauge distance by programming the neck with an angle and pace, and also to double check that your setup and face is actually aimed where you think it is (part of Step 2), then your job is to roll the ball straight away from the face of the putter over the Carpenter's "L". While there are different techniques for putting straight, the technique that I recommend for a straight stroke is a) start straight away from the ball to the top of the backstroke, b) let the shoulder frame rock back down by itself with dead hands, and c) continue the rocking of the lead shoulder straight up to deliver the putter face square thru the back, center, and front of the ball on a slightly rising trajectory down the line. The sweetspot of the putter is used somewhat like a police battering ram lifted by shoulder action straight along the feet to propel the leading dome of the ram into the doorknob. The shoulder action produces a motion in the two hands that run straight above the toes of the feet, without curling around the body back and thru.

THE LEAD HIP ANCHORS THE BACKSTROKE.

Any upper body arcing back to the inside during the backstroke is not especially troubling to the task of resquaring before forward impact, so long as the lead hip stays anchored in place during the backstroke wherever it is set at address. The somewhat elastic properties of body tissues and muscles connecting the lead hip thru the structures of the abdomen and rib cage use the anchored lead hip in the resquaring process coming forward. The hip is "home" and the body muscle and other tissues are the "bread crumbs trail". The trouble arises when the golfer is not mindful of this property of the stroke dynamic, and allows the lead hip to follow along with the upper torso in a backstroke that takes the shoulder frame out of parallel to the target line. But if the golfer simply anchors the lead hip prior to initiating the backstroke, the body itself will quite naturally

resquare itself in a nearly effortless and accurate manner. Any inside turning of the upper torso in the backstroke has this self-correcting feature in the forward stroke so long as the lead hip remains anchored. The body will then naturally close back to square by the bottom of the stroke arc. At this point, the golfer's "staying down in the putt" and not allowing the throat line to swing past square also effectively stops any further closing of the hips thru impact.

"If you have a problem with lower body movement, key on keeping the left hip very firm throughout the swing." — Obitz, Harry & Farley, Dick (1980). Why you need two strokes: Long and short putts pose different challenges and require different methods, *Golf Mag.*, 22(6), Jun 1980, 52-55, at 55.

Anchoring the lead hip at the start of the takeaway is done by a combination of attention to this body part plus balance-managing tension in the lower torso. A slight flexing of the knees at address activates the key leg muscles that maintain balance and equilibrium, and these same

muscles combined with the intention of not allowing the lead hip to follow the backstroke is about all there is to this.

START THE TAKEAWAY WITH THE SHOULDER.

With regard to the takeaway movement itself, moving the shoulder frame so the lead socket heads to the balls of the foot initially and then curls back along the line of the feet will push the "triangle" as a unit straight back from the ball. This is similar to "combing" straight back with the "comb" or "curry brush" of the sole of the putter back and up thru the "flowing hair" of the green. In contrast, if you start the stroke with the hands or arms, the putter head will likely move across the putt line away from you, and this will spoil the rest of the stroke. (Charles, 1969; see also Robert, 1997). At best, you want the shoulders to move the putter away in a straight line or possibly a tiny touch to the inside going back, and any crossing the putt line is absolutely the worst.

When the shoulders are aligned parallel with the target line or even a little closed (as in the case of Bobby Locke's setup), and the motion is powered from the lead shoulder shoving the sole of the putter thru the fixed shape of the "triangle", it is biomechanically impossible to direct the putter head away across the target line.

You will have to teach yourself the benefits of starting the stroke with the shoulder frame so the socket goes down at the balls of the foot. Set up the putter near a wall's baseboard so the toe of the putter is about 1/2 an inch back from the baseboard and use this initial move to show yourself that the toe will not get any closer to the wall, and also will not really go inside much at all and may well go perfectly straight along the baseboard with the toe staying exactly 1/2 inch away at all points in the backstroke. Another training drill is to set down a ball, setup to it, and then place a second ball straight back from the putter head's sweetspot not quite one foot back. Then make the initial move and the putter's sweetspot should back straight away and hit the back ball straight on a line. You can elaborate on this with a third ball even further back on the same line, so that the takeaway move knocks the second ball and rolls it straight into the third ball.

Another experience that illustrates the backstroke comes from the physical rehabilitation ward. People recovering from shoulder injuries have a giant stainless steel wheel axled to the wall, so that the axel rises and lowers along a vertical track so it can be adjusted to match the height of the person's shoulder. The person then reaches down to the bottom of the wheel, where a handle extends out towards the room. The person uses the hand for the recovering shoulder to "crank" the wheel back and up and around in a complete circle. The path of the handle and the hand in the lower half of this circle can be used to train a straight-back shoulder movement in which the arms and hands play no role.

The above action / movement is the same as holding a relay race baton where the hands would initially hold the putter handle at address, with the baton horizontal with the surface and matching the orientation of the putter face and the neck at address. A no-hands shoulder move for the takeaway simply moves the baton back and up on the arc without changing the orientation of the baton.



The same back and up rocking of the shoulder frame in a vertical plane can be practiced and experienced by aligning a shaft of broomstick or similar stick across both shoulders and moving the lead end of the stick vertically up and

down. If the golfer stands next to a flag pole or a door jamb and glides the lead end of the stick up and down the vertical line of the pole or jamb, without allowing the motion of the body to break the contact, this shows the golfer the vertical shoulder action.

Knowing how to perform this action, and what happens with the putter head, the putter face, the hands and the arms with this sort of action, sets the basis for the golfer making choices about other stroke movements. The often-repeated claim that a straight-back and straight-thru stroke requires “manipulation” of the hands and arms in order to keep the putter face square while following this path is simply and objectively incorrect. The reason people make this claim is because they don’t seem to understand how to make a straight stroke with the shoulder motion. While it is true that a somewhat horizontal twisting back and thru of the upper torso and the shoulder frame with it cannot send the putter face squarely back along a straight line

without significant compensatory manipulation of the hands and arms, this is not the stroke motion at issue; the vertical-plane stroke motion simply does not require any hands or arms manipulation and they are moved solely by the shoulder action without independent movement. The steady-form “triangle” shape adopted at address then translates (or “maps”) the shoulder motion directly to the putter head.

THE GRAVITY-TEMPO DOWNSTROKE IS EFFORTLESS.

Once the top of the backstroke is reached, just relax so the shoulder frame sinks back to level. The word “relax” here does not refer to the shoulders, arms and hands — the “triangle” maintains its tone and shape. Instead, what is meant is that the muscles in the abdomen and sides and lower back that connect the upper torso to the lower torso at the pelvis should relax. At the start of the back stroke for a right-hander, the left side’s inner oblique abdominal muscles attached to the rib cage contract to pull the rib cage and hip towards each other, so the shoulder moves down as the torso as a whole flexes laterally. The lower, lumbar spine also flexes modestly. On the opposite side of the torso, the inner oblique abdominal sheet stretches to allow this flexing away from the right hip. At the top of the backstroke, these muscles have to relax for the gravity-sponsored stroke to start down on its own steam. If there is any deliberate torquing required to start or make the downstroke, it is very minor.

HANDS QUIET OR “DEAD” IN THE DOWNSTROKE.

The hands in all this remain inert with the pre-established grip pressure unchanging. There is no rotation of the hands, no manipulation of the hands, and this means the thumbs stay flat on the putter handle in the same plane at all times and that the hands stay the same distance from a plane across the thighs at all times — regardless of backstroke length.



In the picture sequence above, the fingers of each hand all point in a parallel manner with the target line at the beginning. As the stroke progresses without any use of hands or arms, the fingers maintain this mutual orientation (i.e., they stay parallel to the target line and stay out from a plane across the thighs the same distance they started at address). The sign of the body that the arms and hands are remaining quiet and unused is the absence of alteration of the joints at the armpits and the elbows. The golfer does not want to feel the upper arms separate from the side of the chest wall, going back or rocking forward, at least thru the impact zone.

The feeling is a little odd, as if there is a slight curling away from the body as the hands go to the top back, and then drop down again to the bottom, and a slight curling away from the body going forward, but this is illusory. That “feel” is because the “usual” body action keeps the hands close to the hips, and a straight stroke powered by a shoulder rock feels as if it extends the hands away from the hips a bit — similar to the feeling of cranking the large wheel mounted on a wall with axle at shoulder height and handle at the bottom at hand height, as discussed above. You can feel this by setting up over a yardstick and starting back with the shoulder move. You do not have to actually extend the arms or wrist or otherwise do anything with the hands to keep the putter head straight back along the yardstick, but you do have to move the lead shoulder

straight down at the balls of the feet and ignore how the hands and arms feel a bit extended. The odd feeling is correct. Just focus on the shoulders and ignore the arms and hands.

The dropping of the shoulders coming forward from the top of the backstroke is natural enough and just retraces the shoulder rock back, this time coming down. You will need to wait patiently as the stroke falls on its own. If you hurry down, your hands will become active and the face and path of the stroke will get altered into a pull or a push. So just leave the hands out of the fall and be patient. My thought is that the hands are like golf gloves filled with wet heavy sand. The hands stay low and don't do a thing except keep the same grip pressure and hope nothing happens, and there is no new feeling as you "ride the putter" down.

HANDS DO NOT ROTATE, GRIP PRESSURE CONSTANT.

In the backstroke, the hands will want to rotate only when the hands move faster than the shoulder rock. If the hands are moving independently of the shoulders, the forearms will rotate the hands "open" going back or "closed" going forward. The cure is to keep the hands inert, and turn the "triangle" as a unit. This keeps the butt of the handle constantly aimed into the sternum throughout the stroke. Also, the notion of aiming the thumbs straight down the shaft at address and keeping them aimed down this way without turning prevents the putter face from fanning in the stroke. Another thought is to coordinate the shoulders with the putter, so the lead shoulder is the locomotive, the putter head is the caboose, and the two hands on the handle are "sleeping passengers — don't wake them, as they don't drive the train."

The constancy of grip pressure in the stroke back and thru indicates the non-use of hand and forearm muscles. Non-use is tantamount to allowing the downstroke to "complete itself" or to allow "the putter head to do the work". If the grip pressure

is truly constant, then the contact area between the fingertips of the thumbs and the handle will not experience any changes of pressure in terms of stress, strain, or shear forces. The golfer, then, can monitor the contact area under the thumb fingertips as a method for adhering to the gravity-sponsored timing of the transition at the top of the backstroke and of the downstroke. Moreover, the golfer cannot experience stress, strain or shear forces in this contact area without altering the timing of the downstroke.

Similarly, rotation of the forearm in turn rotates the distal wrist and hand. The principal muscle that rotates (pronates) the forearm is the pronator teres in the elbow, which rotates the radius bone (thumb side) outside / over the ulna bone (little finger side). The brachioradialis muscle in the forearm on the thumb side flexes the elbow and lifts the hand to the front and up away from the coronal plane of the body. The non-use or inhibition of these elbow muscles in the lead arm from the top of the backstroke down thru impact is one feature of a no-hands, no-arms stroke. (Martini, Timmons & McKinley, 2000).

“A sudden surge of tension on the forward stroke ruins more putts than anything else.” — Graham, David (1981). How to develop a pressure-proof putting stroke, *Golf Dig.*, 32(9), Sep 1981, 42-45.

HOLD THE THROAT LINE STILL ONCE THRU-STROKE RESQUARES.

“Keep the left side firm. Whatever address you adopt, maintain the left-side position until well after impact while keeping both hands moving through the ball and toward your target. Allowing the right hand to roll over the left before or during contact will ruin any chance of a square clubface at impact.” — Golf Magazine (1987). What all great putters do, *Golf Mag.*, 29(8), Aug 1987, 32-33.

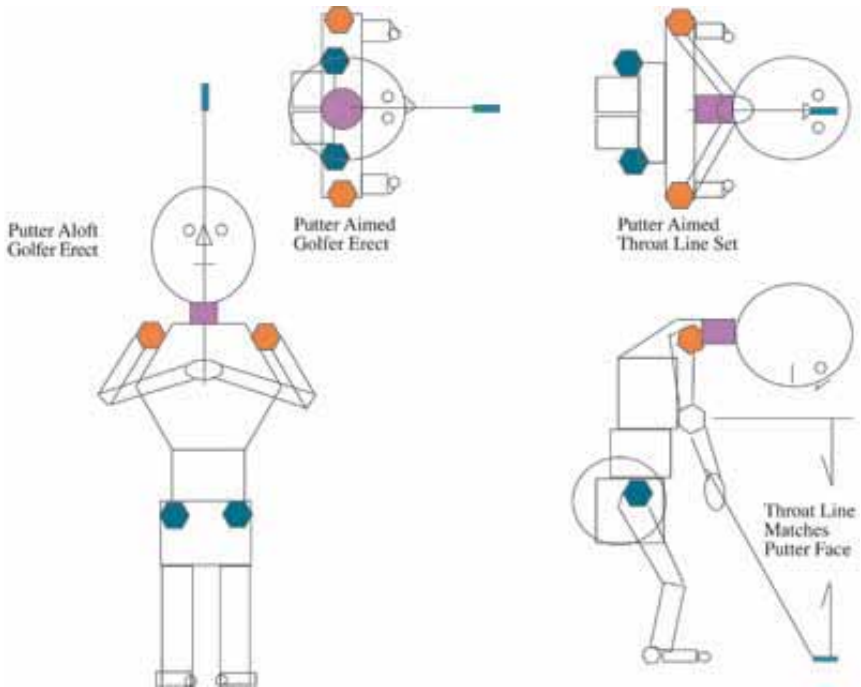
“Be certain to stay down as you stroke through.” — Crenshaw, Ben (1982). Putting: Make more short putts: Analyze your stroke to find and cure your errors, *Golf Mag.*, 24(9), Sep 1982, 58-61, at 59.



The base of the neck intersecting the shoulder frame manages the alignment of the shoulders during the stroke. The throat line from center of chin to base of neck where sternum meets clavicle constitutes the controlling body structure for an accurate, no-hands putting stroke. This part of the body equates to the top cross-bar of a swing set, anchored on one side by the golfer's stance and anchored on the side opposite the ball by the focused will of the golfer in control of his body.

In adopting setup postures, the golfer should align this throat line with the leading edge of the putter face, which in turn automatically aligns the shoulder frame parallel to the target line

as defined by the aim of the putter face. The aim of the putter face establishes a “cross” shape on the ground where the leading edge of the putter face and the aim line of the putter face intersect perpendicularly. The base of the neck makes a cross as well where the shoulder frame intersects the throat line. The setup matches these “crosses”.



Establishing this basic body orientation to the aimed putter face is key to putting straight. At the start of the backstroke and during the backstroke, the golfer uses head-neck control (inner ear balance, neck stabilizers, and hip and lower body stabilizers) to manage any tendency of this top cross-bar of the body to get dragged to the target side of the starting orientation (left of the putter face line on the ground as aimed at address, for a right-hander). At the start of the downstroke, the golfer needs to resquare the upper torso and the throat line to the same extent any change in setup positioning has occurred, and this resquaring motion needs to be complete no later than when

the putter head returns to the starting position it had at address. Then, most importantly, the throat line should never be allowed to swing or arc across the square position any at all, and should simply “hold” at the square position throughout impact. Any rotational wandering of the throat line that otherwise creeps into the stroke must stop sharply and precisely when the throat line resquares.

Biomechanically, once the base of the shoulder stroke stops with the holding of the throat line at square in the middle of the stroke, the momentum of the arms, hands, and putter in the gathering down-and-thru stroke is constrained to track along the alignment of the shoulder frame while propelling the rock of the shoulder frame about its pivot at the base of the neck in a manner that carries the lead shoulder vertically up away from the ground. To the extent the golfer “pulls” the stroke thru impact with the lead shoulder, to that same extent he raises the risk that the lead shoulder will become directed back out of parallel alignment, arcing behind the golfer’s frontal plane, causing a “pull” stroke.

The key insight of all this is that if the golfer manages the throat line astutely, the stroke itself naturally “wants” only to send the putter head square and straight down the line on a slightly rising arc, with the sweetspot of the putter remaining out over the target line, the face remaining square, and the vertically up-rocking of the shoulder frame imparting a rising trajectory to the putter head down the line. This state of affairs needs to persist only briefly thru impact and all is well.

The line of the throat when square to the target line does not need to be oriented horizontally with the surface of the green. It is sufficient if a plane thru the middle of the body that includes the throat line is the same as a vertical plane from the surface that includes the leading edge of the putter face as aimed (the line on the top of the putter face from heel to toe), or is parallel to this putter face plane albeit offset.

The upshot of this technique for making a straight stroke is that by management of the throat in the forward swing, the golfer has nothing else to do except allow the putter head to proceed wherever physics of the natural swing wants to carry it.

The golfer is not concerned about the backstroke path, the forward stroke path, resquaring the putter face, ball position, the thru-stroke path, or any artificial requirements of symmetry in the stroke. Once the top of the backstroke is achieved, the golfer simply resquares the body and putter and then holds the throat at the line and allows the swing of the putter, hands and arms to flow on their natural trajectory without manipulation or micro-management. The momentum of the stroke itself moves the lead shoulder vertically up out of the way.

VERTICAL UPLIFT OF SHOULDER SENDS BALL STRAIGHT.

If the size of the stroke goes outside the minimum size for a gravity-sponsored stroke (as far back as the rear foot), the golfer can choose to give the whole down-and-thru stroke over to gravity, or the golfer can “ride the putter down” to impact and catch the motion in order to add a little finish action thru impact and slightly beyond. In the later case, any torquing thru impact is kept to a minimum so as not to disrupt the instinctive load and impact force. Deliberately torquing the stroke thru impact is asking for all the problems the instincts naturally avoid — human timing, distance control, club face manipulation and changing grip pressure, and the like. If the backstroke stays less than the minimum for full gravity engagement, the golfer has little choice but to torque the stroke, but happily distance is not much of an issue at this range so long as the stroke stays smooth with an evenness in the back-and -thru rhythm.

Ben Crenshaw has always taken the putter inside in the backstroke but in the thru-stroke his putter face stays online rising as the lead shoulder rocks vertically up from the surface. His sometime student Phil Mickelson has the same action in his

stroke. Bobby Locke and Seve Ballesteros preferred paths inside going back and then delivering the putter face thru impact square down the line (Locke, 1972; Ballesteros, 1988).

Finishing the stroke coming forward is catching the speed pattern of the putter downward and then starting the lifting action in the shoulder rock right at the bottom, with the pivot in the base of the neck staying still. The stroke is a "hitless" sweeping away of the ball, which simply gets in the way of a smooth stroke. The line across the shoulders turns with the shaft of the putter to keep the butt of the putter aimed at the sternum. The lead shoulder socket has to go vertically up. If this action were continued until the shaft of the putter paralleled the ground, the putter face would aim straight up in the sky like a waiter's tray. The "normal" and "feel-good" motion is for the lead shoulder to curl back around to the inside, with the hands and forearms rotating inward towards the lead hip, and the uplifting of the shoulder frame is artificial and must be practiced before fully appreciated and enjoyed.

Ray Floyd is a golfer who prefers to add a little torque in his stroke thru the impact zone. He writes:

"My thought is to take the putter back low and slow to the length required for the putt, then gradually accelerate the putterhead through the ball on the forward stroke. That's another reason I call it a pendulum-type stroke. A true pendulum swings at the same rate of speed in both directions, but I feel the putter must be accelerating a bit through the ball. This helps keep both the stroke and the ball on line. It's not a hit, mind you. It's not a jerk. The acceleration is not rapid. The feeling should be one of smoothness and rhythm in both directions, slow going back and gradually gaining velocity going forward. Because of this acceleration, the follow-

through should be slightly longer than the back-swing." (Floyd, 1992, 55).

Once you get the feel of the shoulder socket lagging the whole heavy left arm and hand straight up from the foot as the putter head rises into the back of the ball, you will feel an extremely smooth and solid impact of the lower half of the putter face as the sweetspot lifts on a slightly upward path from the back of the ball thru the center and out the front of the ball, entering the back about one dimple below the equator and coming out the front of the ball about one dimple high of the equator. The ball will not jump or hop off the face, but will make a very pleasing "pock" sound and roll smoothly straight off the face, down the stem of the aiming "T" and the Carpenter's "L".

"If you watch a true pendulum you will see that it gradually swings upward as it moves away from its lowest point. So does my putter. I make no effort to hold the club low to the ground either going back or stroking through the ball. I simply let it follow its natural -like rise and fall."
— Charles, Bob (1969). The soundest way to putt, *Golf Dig.*, 20(11), Nov 1969, 30-35, at 34.

"At the moment of impact, direct the hands and blade as one unit through the ball to the completion of the stroke. ... The club pulls the hands to impact, the hands don't pull the club. That is, once you've started the stroke, the sweep motion is almost automatic." — Golf Magazine (1973). *Golf Magazine's Handbook of Putting* (New York: Harper & Row, 1973; London: Pelham, 1975), 54, 60.

"Once I start the putter back, it seems as if the stroke completes itself."
— Ben Crenshaw, summarizing in one sentence his experience over decades of putting.

Ultimately, the ideal is to let the down-swinging momentum of the putter head define its own trajectory thru impact and beyond. This momentum in itself will "move the lead shoulder vertically up out of the way", as the golfer maintains the "triangle" form but "allows" the putter to swing without impeding

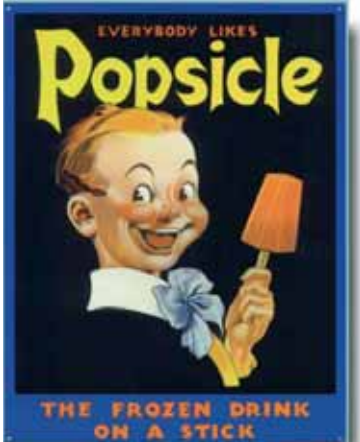
its momentum. This “allowing” the stroke to occur on its own time and path conjoins the tempo timing of touch with the straightness of the stroke. Both distance and line reduce to the same timing.

HEAD MOTION IN THRU-STROKE.

“I’m trying to make sure my head and my knees move a little and my stroke feels longer,” he said. “Because when it feels like that, I always putt real well. But every once in a while, you start getting a little careful, and you try to make sure your head stays still. And if your head stays too still, you lose your feel and you start putting badly. You can never putt well without feel.” — Ben Crenshaw, quoted in Rotella, Robert J. & Cullen, Bob (1995). *Golf is not a Game of Perfect* (New York: Simon & Schuster, 1995), 97.

In the forward stroke thru impact, with the base of the neck holding at the mid-line and the shoulder frame therefore rocking in a vertical plane, the base of the neck will necessarily swivel unless constrained by neck tension. If the neck swivels, the head on the neck acts like an “inverted pendulum” with pivot in the base of the neck. Thus, head motion as a reaction to the shoulder frame rock is not a problem for the thru-stroke. To the contrary, holding the head against the action of the shoulder frame places tension at the base of the neck that the rising shoulder frame encounters like a rock in the stream. Golfers will either experience the shoulder frame go around this tension with a rotation back away from it (a “pull” action) with spoiling of the line, or will learn subconsciously to “break thru” the tension with a jabbing action in the stroke that does harm to distance control. On balance, not worrying about the head action is preferable and more natural.

The head is an inverted pendulum, like a popsicle on a stick. The pivot of the putting stroke is at the base of the neck, where the shoulders are connected together by the clavicles at the top of the sternum. This is where the fanciful “top bar of the



swing set” extends over the midline of the stroke to match the top edge of the putter face, as does the throat line. This point is where the bottom of the popsicle stick is located. So long as this point simply spins, rocks, or rotates in place, all is fine with the stroke, but the popsicle at the upper end of the stick will want to rotate like a buoy.

The natural golfer putting instinctively is concerned mainly with the base of the neck or bottom of the popsicle stick remaining above the midline of the stroke arc. A little ease and comfort at the base of the neck from beginning of stroke to end of stroke best promotes good touch and line control. The musculature that holds the head still in place while the upper torso moves is that set of muscles in the neck “tethering” the head to the top of the spine, holding it down like so many hot-air balloon guide ropes. Because the neck is bent forward at address, the weight of the head is mainly held by muscles attaching to the back of the head.

An instinctive way to maintain the head position in a meaningful way without undue tension or attention is to nod the head at address. As described in a 1952 article:

“When we nod the head, we use the hinge joint which lies between the head and the first bone of the neck and the second. A similar contrivance in principle is used in the frame or mounting of

the telescope. Players are told to keep their heads down, also to keep their chins back, etc. Such phrases have really very little bearing on what actually should take place. The head itself must be allowed to fall exactly as in THE ACT OF NODDING, plus a very slight equatorial turn to one's right, just sufficient to be in accord with one's shoulders [when the rear shoulder is lower than the lead shoulder at address]. Thereby one looks at the back of the ball. ... If you ask a friend to place his hand underneath the forehead, once this position has been attained (as in nodding) it will be found practically impossible to push one's head upwards at all. The relaxation caused by the looseness in the neck makes it almost impossible to even push up one's head during the period of the entire swing. It may turn somewhat but it won't rise. ... This structure, composed of ball and socket joints, should remain as in a state of ease from the beginning to the end. So, when and if there is movement in the neck at all, which is very possible at the ball or slightly later, then only use the equatorial turn, but avoid entirely the lifting motion or upward left."

(Reid, 1952).

The choice then boils down to tension in the top of the back to stabilize the head while everything immediately below (proximal) the head is moving in the stroke, or to simply nod the head into position and focus on the "top bar of the swing set as anchored on the golfer's end at the base of the neck" not shifting targetward in the thru-stroke ("keep the left side firm", "stay down on the stroke", etc.). Ideally, thru the impact zone the axis of the head (throat line) remains centered, but if the head "rolls or swivels" equatorially a little with the face pivoting a little down the line, this does not harm the accuracy of the stroke. Allowing the slight carriage of the head in this

equatorial manner as the shoulder frame rocks up seems preferable to attempting to lock the head in position and thereby adding tension that is not strictly required, as this tension occupies the critical “Khyber Pass” where the shoulder frame meets the neck on the lead side of the neck. The golfer does not want any resistance to the up-lifting of the shoulder frame at this particular time, especially if the golfer uses a casual tempo with only slight forces from the gentle momentum of the stroke itself to move the shoulder frame out of the way of the straight-running putter head and “triangle”.

PUTTER FACE STAYING SQUARE THRU IMPACT ZONE.

When the golfer successfully performs the straight stroke motion, the putter head transits thru the impact zone in a specific way:

- the putter sole flattens back to the surface just above the turf possibly brushing the tops of the grass blades right at the bottom of the stroke immediately before impact;
- the putter head starts to rise as it swings further down the line into the back of the ball, played an inch or two in front of the bottom of the stroke;
- all points of the bottom of the leading edge of the putter face and the sole of the putter rise together evenly off the surface like a naval jet taking off from the deck of a carrier at sea, regardless of the orientation in gravity of the deck;
- the sweetspot of the square putter face remains centered over the target line thru impact for at least a few inches if not for a foot or two past impact.



If you took a photograph of a straight-stroke golfer from the target looking back down the line once the golfer's putter head is about one foot into the follow-thru, those golfers who maintain the stroke thru impact in the vertical plane present a square putter face at this point, whereas others have allowed the putter face to close and aim to the inside, with the sweetspot of the putter also wandering offline to the inside.



Square and online



Not square and online



Not square and online

THE AIMING "T"

When golfers practice straight strokes over a chalk line or under a string line, or even inside a stroke track set for a straight down-the-line-thru-impact stroke, the sweetspot stays out over the line and the face remains square and moving squarely at the target for a decent interval past impact. On the course, however, the golfer needs to relate to the geometry of the putter face and ball alone in order to perceive in advance how the thru-stroke should proceed in space past impact. This is quite simple: the putter head always defines a "T" shape behind the center of the ball, with the top of the "T" being the leading edge of the putter face as aimed and the "stem" of the "T" being the aim mark extending back from the sweetspot (or the implied direction in the shape of the putter head from front to back). And a mirror "T" opposite the putter face has its "stem" aiming down the line towards the target. With these two "T"s matched together top to top, the shape is a cross on

the ground. The end point of the stem that points at the target ought to be 5-6 inches from the center of this cross.

[The aiming "T" is discussed in more detail in connection with aiming the putter face, in terms of standing behind the ball, seeing the line, and identifying a point at the end of the stem that is also on the true line from ball to target, to use when walking into the putt and aiming the putter face down this stem line at the end of the stem (a spot on the grass 5-6 inches in front of the ball). While aligning the putter face to aim at a spot shortly in front of the ball is well known (e.g., Trahan, 1997), the use of this spot to organize and execute the stroke is less well known (see Stockton, 1996).]

Knowing and perceiving this cross and the down-the-line stem and end of stem at address helps the golfer know where the putter head should go thru and past impact: the sweetspot of the putter needs to stay out over the stem at least until it passes the end of the stem while remaining square to the target line. And this geometry is ever present on the course, for every putt. If the golfer wishes to remain free of independent arms and hands movement (manipulation) while also accomplishing this dynamic, the golfer simply maintains the throat line at the middle of the stroke arc and allows the putter head to define its own trajectory thru impact by this momentum and the alignment of the shoulders and allowing the lead shoulder to be up-lifted by the stroke itself. Otherwise, the golfer will necessarily be forced to use fragile hand-eye coordination and manipulation putt after putt. Standing still and letting the stroke take care of itself seems greatly preferable for its simplicity, naturalness, and consistency.

THE STRAIGHT STROKE AND TIMING.

Timing consistency is key to a repeating straight stroke. If the timing is right, the stroke rolls the ball straight. Why would that be the case?

When the timing is consistently the same, the downstroke timing to impact is known in advance with very good precision, as is the timing all the way to the end of the stroke. This timing precision allows monitoring of the forward stroke for en-route error, but it also serves to establish a future positional goal for the stroke (as when the sole again flattens to the surface at the bottom of the stroke or the final “look and feel” of the top of the follow-thru). These future, time-labeled body postures are used in the brain to guide the stroke movement with fast-acting feedforward processes that in general are superior to error-correcting compensations based on feedback. (e.g., Fel’dman, 1986; Georgopoulos, 1986; Marteniuk, 1992).

With respect to a gravity-timed downstroke, leaving the putter alone is the optimal dynamic that most consistently generates a straight stroke thru impact. And this is precisely what gravity and the instincts demand of the instinctive golfer for this stroke, as the human has no role in the downstroke to impact other than to spoil the invariable timing inherent in the physics. This is true to the point that simply making sure impact occurs on the correct count is a guarantee that the stroke has not been spoiled and thus the down-the-line swinging of the putter has been preserved.

SUMMARY OF STRAIGHT STROKE

The golfer manages the biomechanics in the aligning of the shoulder frame parallel to the target line and then in the maintaining the throat line to remain at the middle of the stroke arc going forward thru impact, gracefully and with little violence and tension. The momentum of the forward “swinging” of the stroke “triangle” and putter head will follow the shoulder alignment so long as the throat line holds the middle thru impact, and this momentum rising past the bottom of the arc into the follow-thru will also up-lift the lead side of the shoulder frame in the vertical plane, and the golfer simply anticipates and allows this to define the upward rocking of the shoulder frame. If the head swivels the face to keep up with the action

of the shoulder frame, there is “no harm, no foul” in this. And if the top of the head “bobs” back like the top of a buoy, but the base of the neck and throat line remain unaffected, there again is “no harm, no foul.” The more the orientation of the neck approximates parallel to the surface, the less tendency there is for the top of the head to be involved in the thru-stroke and any head action is more confined to equatorial swiveling. The instinctive stroke then, has certain biomechanical requirements that accompany the knowledge of cause and effect in movement, by which the golfer knows what matters and why: the shoulder alignment, the throat line, the self-determining momentum of the stroke thru impact. Once the biomechanical dynamic of hip, shoulders and throat line is experienced, the golfer simply starts the backstroke, holds still, and waits for the putter to find its own way straight down the line.

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Chapter 6: Aiming Accurately.

SKILL 2: AIMING AND SETTING UP AT TARGET.

While golfers may be okay sighting a line from ball to target near hole from behind the ball and then positioning the putter face to aim down this line when setting up, golfers are not good at all in then looking down at the putter face at address and turning targetward to “see” whether the putter face aims where it is supposed to be aiming. This flawed perception building beside the ball leads to mis-aiming the putter face, and a mis-aimed putter face corrupts the ability to putt straight where the putter face has been aimed. The reason is simple geometry of eye direction (gaze), head-neck orientation at address in relation to the aim of the putter face, and rolling of the head and face targetward to run the line of sight down the line of aim, plus knowing what is the spot that matters once the eyes and face are aimed down this line.

The aiming routine proper has three stages: first, seeing the line from ball to target while standing behind the ball; second, placing the putter face behind the ball so that it aims down this target line; and third, setting up beside the ball and “checking” where the putter face in fact aims from this perspective. Only when the aiming of the putter face from behind the ball agrees with the beside-the-ball checking will the golfer feel comfortable executing a straight stroke that rolls the ball the same direction the putter face aims. The following passages proceed thru these aiming stages in order.

Bottom line: In order to see accurately from beside the ball where in fact the putter face aims at some distance across the green, 1. align the throat line to match the putter face's leading edge, 2. "face" the ball and also look with the eyes wherever you face, then 3. pivot the head like an "apple on a stick" to run the fixed-gaze line of sight in a straight line sideways along the ground, with this line being the same line of aim of the putter face, as far off as the target near the hole. At the end of the head swivel, the straight gaze is geometrically guaranteed to aim at the same location the putter face aims. To simplify further, if the golfer closes the lead-side eye and aims the other eye the same as the face, a point in this eye's field of vision about 1" laterally in from the bridge of the nose will aim at the exact spot where the putter face aims.

STAND BACK

THE SAME DISTANCE AS THE PUTT LENGTH.

First, stand behind the ball the same distance as the distance from ball to target, within reason. This gives you multiple doses of the distance of your putt without you having to think about it. This particular perspective also gives a special relationship in the apparent length of the segments of the distance from golfer to ball, and from ball to target. This advice generally applies out to about 30 feet, unless it requires leaving the green surface or standing on a substantially different slope.

USE ONLY

THE DOMINANT EYE TO SIGHT LINE.

Position your dominant eye on a projection of the "line" back to you, with your torso and face directed straight into the line and with good posture and a straight gaze out of the face. If you are right-eye dominant, your right eye and right lung is "on" the line, not your nose; if left-eye dominant, your left

pupil and heart are “on” the line. (Stockton, 1996). I think of a vertical plane rising up from the line so that my dominant eye is “in” this plane of the putt line and my torso is squared to this plane. (To test eye dominance, see <http://www.archeryweb.com/archery/eyedom.htm>.)

USE THE PUTTER SHAFT AS A VISUAL RULER.

You can then raise your putter shaft to use it as a visual ruler and connect the center of the ball with the center of the target along one edge of the shaft and look along this edge line with your dominant eye. The ruler will show you the exact back of the ball to square the face up to, the orientation of any writing on the ball in relation to this back of the ball, the orientation of any shadow behind the ball, and all blades of grass behind and in front of the ball exactly on the line, specifically including the end of the “stem” of the aiming “T” as a spot just in front of the ball a few inches to use as an anchor for aiming the putter face.



Walter J. Travis

Using this ruler with one eye closed eliminates any issue of eye dominance or visual parallax: the ball and target are either connected by the edge of the ruler or they are not. In fact, all people see exactly the same line of grass blades along the true line between ball and target, and this procedure will identify the same true line repeatedly.

ANCHOR TRANSIENT PERCEPTIONS ON THE GROUND.

Use these reference points on the ball and ground to “fix” or “anchor” the location of the “line” that you now accurately perceive from this perspective behind the ball, and find the end of the “stem” of the aiming “T” that is on the line 5-6 inches in front of the ball (see below for more on the aiming “T”). Once you start walking to the ball to place the putter head, you will lose the sense of the line’s location without these anchors. While walking into the ball and stepping around to the side of the ball, keep your eye on the reference spot just in front of the ball. If necessary due to the difficulty of keeping the spot in sight, keep the visual ruler locked on the ball and target and aiming reference spot as you walk into the ball from behind, and re-sight the reference spot once nearest the ball on the line before stepping around to the side of the ball.



WALK THE LINE TO KEEP THE PERSPECTIVE.

Remember that the back of the ball is only the back of the ball as seen from the one specific perspective that accompanies the true line from ball to target. If you shift off the line to look towards the ball, you will see an entirely different “back” of the ball, and it will be incorrect. I think of looking at the back of the ball as looking at a dartboard hanging on a wall, so I realize that even if I move off the line and change my perspective, the wall will stay perpendicular to the original line of sight. Another way to think of this is that the “ball” is actually a sleeve box with the long part of the shape aimed straight at the target. Then, when you start to walk to the ball, walk straight along the line into the back of the ball without altering the perspective, and keep the anchor points in mind. You can also

walk into the ball while still keeping the ball and target connected by the visual ruler if you like.

POSITION THE PUTTER FACE IN LIGHT OF ANCHORS.

Once behind the ball, then you have to reconstruct where to place the putter face so it aims directly thru the center of the ball in the only acceptable direction — straight thru the center of the ball at the target. This is where the anchors and the manner of approaching the ball pay off.

The one thing to avoid at this point is attempting to “aim” the putter face at the target, as the postures and positions at this juncture are not well placed to generate accurate perceptions. And besides, why neglect the good work you’ve done from the straight-forward perspective behind the ball? Simply aim the putter face thru the center of the ball at the anchor spot, and then wait until the postures are set up to the putter as aimed before attempting to generate accurate perceptions of where in fact the putter face now aims.

BALL ITSELF & PUTTER HEAD SHOW THE LINE.

If you have steadily identified the exact back of the ball, this point on the back equator necessarily defines a “line” thru the ball, from this back point thru the center of the ball. This “line” continues out the front equator of the ball, exiting the ball right where the round edge of the ball is closest to the target. This line thru the ball itself aims down the “stem” of the aiming “T” over the spot at the end of the “stem” (see below). This “line” thru the center of the ball **MUST** coincide with the line from ball to target (the putt line). The putter face is then squared to this line thru the ball, down the “stem” and across the spot, which squares the putter face to the target also. To square the putter face thru the line of the ball, the sweetspot of the putter has to be positioned on the back center of the ball and **ALSO**

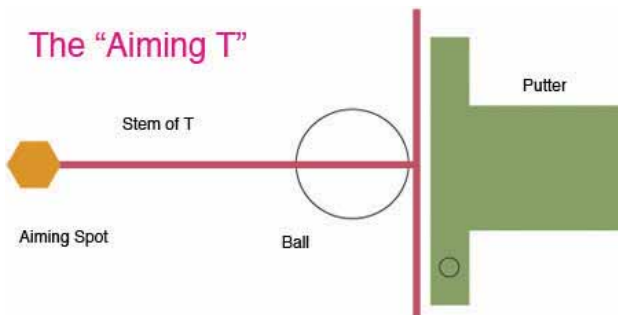
the face has to be rotated until the face is flush and square to the line thru the ball.

PUTTER SWEETSPOT AND PERPENDICULARITY OF FACE.

There are two separate aspects to squaring the face thru the ball (sweetspot and line of ball perpendicular to face). Of these two, the squareness of the face is more important for the line of the putt, but having the sweetspot of the putter moving thru the sweetspot of the ball is more important for distance.

THE TWO T'S.

The putter head makes a T. The leading edge of the putter face is the top of this T, and the aim line extending back from the face is the stem of this T. There is another T thru the ball that matches the aim line of the putt on the ground. This aiming T has a stem that extends from the exact back of the ball's equator (as seen from behind the ball when sighting the "line" on the ground from ball to target) out the opposite point on the front equator and then along the ground on this line as far as a reference spot on the ground identified also when sighting



from behind the line. So long as the golfer can see these points on the ball and on the ground, he can see the stem of the aiming T. If he can see the stem,

then he can also see the top of this T. This aiming T is exactly fixed in space regardless of any fluctuations in the golfer's perceptions or memory of perceptions and is "findable" so long as the golfer can "see" any two of these points on the ball or ground or can see the aim spot at the end of the stem and the

center of the ball. The golfer then simply matches the putter face T to the aiming T, and he's "good to go."

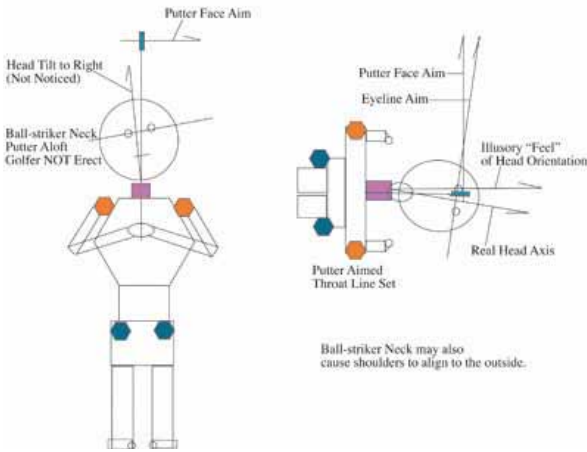
SET UP TO THE PUTTER AS AIMED.



To leave the putter face as aimed from behind the ball, the golfer supports the poised handle on the underside with one hand and walks to beside the ball. The setup itself proceeds from the top down, with the golfer first setting the throat-line into alignment with the leading edge of the putter face. This process requires that the golfer use good posture of the neck perpendicularly out of the shoulder frame or the result is either poor aiming posture or poor shoulder alignment or both. With good posture, the throat-line extends perpendicularly out of the shoulder frame, and thus setting the throat-line to the putter face's leading edge automatically sets the shoulder frame parallel to the target line of the putter face.

ASIDE ON "BALLSTRIKER'S NECK".

Many good ballstrikers have what I term "ballstriker's neck", which is a tilting of the head to the rear side (right for right-handers) that results from hours on end beating balls on the range in the "modified K" setup posture. Eventually, the guide wire muscles of the neck that anchor the head to the top of the spine become out of balance, with rear-side neck muscles



stronger and lead-side muscles stretched more. This head tilt creates a significant problem when brought onto the dance floor of the green. “Ballstriker neck” corrodes accurate aiming and places undue emphasis on use and reliance upon

the dominant hand and side for the stroke.

Of course this postural asymmetry “feels comfortable and natural” to the afflicted golfer, but it needs to be trained out of the system of putting for the sake of improvement. Most golfers with “ballstriker neck” are not aware of this or its influence on posture, perceptions, and movements on the green. So, golfers should stand before their mirror and check whether their two pupils are aligned level with the floor or whether one pupil tilts lower than the other. Ultimately, the golfer needs to strengthen the weaker side of the neck.

NEUTRAL HANGING OF ARMS AND HANDS IN GRAVITY.

Next, the golfer hangs his arms and hands naturally from the shoulders (one hand still supporting the putter handle reaching out to the handle a bit) and then walks the freely hanging hand out to the poised handle. With the elbows directly beneath the shoulders and above the balls of the feet, and the hands slightly forward of that over the toes (as the vast majority of people’s arms and hands hang naturally), the golfer moves each hand inward laterally onto the handle. The golfer avoids “reaching out” to take hold of the handle, as this disturbs the neutral and

tension-free relationship of the hands and arms hanging plumb in gravity.

Walking the hands out to the poised and aimed putter handle is similar to rolling a crane forward on a gantry. The golfer walks his hanging arms and hands out to (or back away from) the poised and waiting handle to properly “dock” with the handle without the arms and hands reaching out of their natural hang. Only then should the hands take a grip onto the putter handle.



Top: feet too far from ball
Bottom: feet too close to ball

As a test that the golfer is the correct distance back from the ball, the golfer can simply relax and release the right hand and watch passively to see how it swings off the handle: if the hand swings only side-ways, the golfer is at the correct distance back from the ball so that the arms and hands hang naturally; if the hand swings towards the thighs, the golfer is standing too far back from the ball and is reaching out to the handle; if the hand swings towards the nose, the golfer is standing too

close to the ball and is reaching back in to the handle. (Lunke, 2004). The mere fact that the arms and hands swing to a new position when allowed indicates that tension is holding them against gravity in the un-neutral position to begin with. This tension is not as stable as simple relaxation into the heaviness of gravity, yielding rather than opposing.

SETTLING DOWNWARD FROM THE TOP.

The essential matters of setup now taken care of, the golfer is free to “settle” the remaining joint pairs of the lower body (hips, knees, and ankles) downward beneath the shoulder frame alignment into “happy feet” (i.e., a comfortable, balanced, stable stance). Some asymmetry in hip alignment may be tolerated, and the heel-toe axes of the feet do not necessarily need to square up to the target line. The function of the lower body is to create a comfortable, natural, stable base in light of the likely level of control required to maintain the shoulder alignment during the forward stroke. A golfer with a casual, relaxed stroke can afford a narrow stance more than a golfer with a quick, violent stroke.

GRIP FORM AND SETUP.



After the lower body has settled into a stable stance, the golfer then shapes the exact grip form and sets the hands properly onto the handle. The grip is last in the setup.

The grip form serves a complex of purposes: balancing and ordering the relative roles of the two hands, taming dominance or promoting it, and avoiding problems in the stroke. Almost all golfers seem

to agree that the left hand guides the putter face thru impact. There is a pronounced difference of opinion as to whether the dominant hand does or should control the stroke or whether a “no hands” stroke is preferred, and the grip forms adopted are usually justified based on these first two purposes and choices.

The clear majority of golfers use a “reverse overlap” form, but I view this as an “accidental” (ornithological term for a bird found beyond its normal range) belonging to the era of yesteryear. The reverse overlap grip is designed to “prevent left-wrist breakdown” in the thru-stroke, but for a golfer trained to use the shoulder frame to make the stroke without powering the stroke with the hands, there never is any left-wrist breakdown so the grip form is irrelevant and valueless. Moreover, this grip form emphasizes the right or dominant hand unduly, as this is the hand first attached to the handle and most in direct contact with the handle.

In addition, because the right side of the brain operates the left side of the body, combined with the fact that for right-handed players the target is off to the left and the left side of the visual world is ported to the right side of the brain, combined with the further fact that the right side of the brain has the dominant role in visuospatial awareness of objects and locations in the environment and sense of body in space (e.g., Gazzaniga, 1970; Gazzaniga & LeDoux, 1978; Fairweather & Sidaway, 1994; Fairweather & Sidaway, 1995; Halford, 1981; Hammer, 1982; Kimura, 1969), the LEFT hand is the better hand in this case for aiming and guiding the stroke down the line towards the target.

Besides, the hand that “pulls” the wagon along is better suited to pull the wagon straight than the hand behind that “pushes” the wagon. Hence, the hand on the target side should be the hand primarily in contact with the handle, while the other hand overlaps this primary hand and has a reduced role in influencing the stroke (at least for right-handed golfers).

This push-versus-pull rationale does not directly answer the notion that rear-hand dominance in the stroke serves a movement very like tossing a ball underhanded towards the target. (Crenshaw, Miller in *Golf Magazine's Handbook of Putting*, 1973, at 60; Stockton, 1996, at 60). This notion places both direction and power in the province of the dominant hand. My personal experience over twenty years, however, is that learn-

ing to trust the aim and guidance of the front-side or non-dominant hand is a long-term project simply due to biased attitudes, but once the golfer admits the superiority of the left hand (in particular, for a right-handed golfer), that golfer will not willingly return to guidance by the dominant hand.



Left-hand low grip

The placement of the left hand mostly in contact with the handle is characteristic of the “left/lead-hand-low” grip form, which operates to reduce the role of the rear/right or dominant hand. This is also the function of the so-called “claw” grip.

“Two pistoleros” grip. A good shoulder-stroke grip, then, forms the left hand onto the handle first, to serve to guide the stroke and also to subdue the influence of the dominant hand. This is done by aligning the “life line” of the left hand with the top left edge of the putter handle (for handles with the typical “flat” surface on the front of the handle). The “life line” at the base of the thumb pad is created by gravity when the golfer’s hands and arms are hanging



naturally, and expresses the fact that the forearm angles slightly forward due to developmental muscle tension on either side of the elbow. As it happens, then, the life line “falls” into alignment with the axis of the forearm when the hand itself at the end of the forearm angle falls back into gravity straight down,



the same as the upper arm hanging vertically beneath the shoulder socket (the blue line at right straightens out with the forearm red line). Consequently, by forming the “life line” onto the edge of the handle, the putter shaft is then aligned to the same angle as the axis of the forearm when a properly fitted putter rests flat to the surface. This arrangement avoids tension in the forearms, wrists, and hands

needed to “hold” the handle at any orientation other than the relaxed, freely hanging orientation of the hands, thus eliminating one source of possible change during the stroke as would occur with slight loss of this tension used to oppose gravity.

By positioning the left thumb so that it aligns straight down the handle axis, the naturally-hanging hand then has the back of the hand square to the target line, the same as the putter face. Thru impact, this orientation of the back of the left hand is responsible for keeping the putter face square, and the golfer learns a great deal about this by close attention to whether the left thumb remains flush to the handle without twisting or pressure changes during the stroke, especially during the forward stroke thru impact. In the setup, the golfer wants to note especially the chosen level of thumb pressure onto the handle created by holding the thumb onto the top surface against the last three fingers closing towards the thumb from the underside of the grip. This thumb pressure forms a “flat tire” oval shape of the thumb tip’s surface against the “road” of the flat handle. The golfer wants this oval shape to feel symmetrical, without differential pressure to one side or the other, and wants this feeling to remain unchanged during the stroke, especially thru

impact. Maintaining this “flat tire” feeling thru impact essentially aids the maintaining of the putter face square.



ESTABLISHING HOMOGENOUS MUSCLE TONE FOR FORM.

With the postures and positions of the body set, the golfer turns attention to so-called “grip pressure.” The hands are not separate in terms of muscles and tendons from the forearms, and neither are the forearms separate from the upper arms and shoulders. Consequently, the notion that the golfer is chiefly concerned ONLY with the

muscle tension or pressure of the hands is not accurate. The so-called “grip” pressure for a shoulder stroke involves the level of tension in the hands, wrists, forearms, upper arms, shoulders, pectoral chest and top of back — all as a unitary “triangle” form (a “Y” when including the putter). This muscle tension need not be “tight” in order to establish a sense of “sameness”, but it should be sufficiently tight to resist the impending forces likely arising during the stroke motion. Roughly speaking, on a scale of 1 to 10 with 10 being a “death grip” and one being a “dead fish flaccid handshake”, a muscle tone in the vicinity of 2-4 is about right, depending somewhat on the chosen tempo and the length of the putt.

Setting a grip pressure in the hands that is noticeably tighter than the muscle tone in the forearms and the rest of the “triangle” activates the brain’s sense of the hands as isolated body parts and thereby encourages “handsiness” in the making of the backstroke and the thru-stroke, especially handsiness with the dominant hand. Similarly, with respect to the dominant hand only, if the golfer positively impresses the right thumb tip onto the handle against the “hold” of the last three fingers of

that hand beneath the handle, this amounts to the same grip form used to swing a hammer or twist a screw driver, and this form is overly associated in the brain with “manipulative use of tools.” This grip aspect should be avoided then, to discourage over-controlling tendencies of the dominant hand. In fact, golfers suffering from this flaw tend to “guide” putts and “pull” putts off line, such that changing to a “claw”-like grip with the dominant hand returns the action to a shoulder stroke movement without handsiness. The problem is more easily avoided by simply not activating the dominant hand by keeping this hand’s thumb relaxed and not positively engaged with the handle beyond a comfortable tone.

With the left hand completely meshed with the form of the putter handle, the right hand then overlaps the left in a non-dominant attachment. So as not to shift the shoulder frame out of level (with one shoulder higher and one lower than the other), the right hand remains hanging naturally without extra bending of the elbow or extension of the hand downward. The right hand’s last three fingers simply overlap the last three fingers of the left hand already on the handle, and the right thumb just relaxes on top of the left thumb however it wants. In overlapping the last three fingers, the right hand fingers are offset lower than the fingers of the left hand by one-half a finger, with the underside of the overlapping fingers fitted in between the tops of the left hand’s fingers (triple overlap). The right pinky, for example, sits in the valley between the left pinky and the left ring finger. The index fingers then drape in a relaxed manner alongside the handle, with the fingertips not deliberately pressed down the shaft axis but perhaps slightly angled to the underside of the handle, the upper sides of the index fingertips in casual contact with the side of the handle.

I call this form the “two pistoleros” grip. Each hand appears separately in the form of a pistol. The emphasis is on the left hand and the left side of the triangle and control of the stroke mostly with the left shoulder leading the backstroke and play-

ing the critical role thru impact. In effect, this form results in a “left hand low” setup style but dispensing with the “low.”

CHECKING AIM OF PUTTER FACE FROM BESIDE THE BALL.

Once the setup is adopted, the golfer will never resist the urge to take a final look to verify the sense that the putter face is accurately aiming at the target as desired. If this is to be done, the golfer needs to know how to do it correctly so that the body action generates accurate perceptions of where the putter face actually aims, instead of the current process that simply directs the face and eyes off to the side somewhere and then redirects them to the target and thereby concludes in a wish-fulfillment manner that the putter face appears to be aiming where the golfer is then looking.



L: gaze down cheeks; C: face not aimed at ball; R: head-face turn sends sight off line.

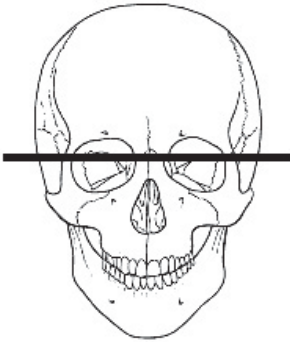


L: gaze straight out; C: face aimed at ball; R: head-face turn sends sight down line.

The key to accurately perceiving the aim of the putter face is realizing how a fixed and straight-out gaze is necessary when the head swivels targetward in order to keep the line of sight running straight and true along the ground. If the line of sight angles down out of the face, the head swivel directs the line of sight on a curl off the the inside of the target line. The longer the putt, the worse this effect. A line of sight straight out of the face, however, works with a head swivel to propel the line of sight straight away sideways.

SQUARING SKULL AND THROAT LINE TO PUTTER FACE.

In setting the gaze to the putter face, you want to a) look straight out of the face, and b) make the “horizon line” across both eyes match the intended putt line thru the ball straight perpendicularly away from the putter face. This “skull line” is a line across the bones of the head that includes the tops of the ears, the temples, the outside corners of the eye sockets, the inside corners of the eye sockets, and the bridge of the nose (9 points). When the gaze of the eye-balls is also directed straight out of the face, this skull line then also includes the two pupils (11 points in a line). You carry this “skull line” with you everywhere, everyday, so use it playing golf.



The “horizon line” across both eyes is how the bones of the head are oriented when you are standing with upright posture on a seashore gazing out to sea — the horizon line of the far ocean is a level line right across your two pupils and the bridge of your nose, and also crosses the inside corners of your eye sockets, just above the outside corners of the eye sockets, and just above both ears. If you held the shaft up so that it matched the sea horizon, the shaft would also match the “hori-

zon line” across these features of your facial bones and your pupils. You carry this “eye line” wherever your face is aimed.

HEAD TURN TO CHECK AIM OF PUTTER FACE.

Setting the eye line to the putt line while also “facing” the ball and line with a straight gaze allows you to use a side-on head turn that moves the line of sight in a straight line along the ground straight away from the putter face. And this line the sight runs down is the SAME line the putter face aims down. In this fashion, you can assess just exactly where your putter face is really aiming and see that your setup and putter face aim is good to go.

For this to be done correctly, you have to know that your gaze is directed straight out of your face, that your eye line is perpendicular to the face of the putter so it runs true to the aim of the face, and that your head turn is accomplished with the axis of rotation steady and the top of your head kept in one point in space as the turn progresses. Then you just turn without anticipating where your line of sight ends up, and wait to see if your sight ends up pointing right at the target. If yes, you’re good to go. If not, you have some unresolved aiming conflict between aiming from behind the ball, aiming the face thru the ball, and checking the face aim from beside the ball. You will have to try again, either just the side-on check, or adjust the face and resettle the feet and try the side-on check anew, or recycle to back behind the ball and start over — your choice.

Once you have a “go” signal, you are square in aim and setup and should simply putt straight, sending the ball over the stem of the “T”. The nice part is that once you have finished aiming at the target, you can go brain-dead and forget about the target entirely. Just make the same-everytime stroke. The TOUCH will be there by virtue of the TARGETING you’ve already done and the backstroke length just happens naturally. So just putt straight, with happy feet and the usual smooth tempo.

TRICKS FOR THE STRAIGHT-OUT GAZE.

A straight-out gaze sounds simple enough, but my experience and the actual habits of nearly all golfers clearly indicate otherwise. These elaborations on the theme, then, seem required:

- A straight-out gaze does not direct the eyeballs down the cheeks as if looking thru the lower section of bifocals;
- A straight-out gaze aims the line of sight flush out of the face perpendicular to the “Coronal plane” of the body (also called the “Frontal Plane”);
- A straight-out gaze aims the eyes where an arrow points if the arrow sticks thru the back of the head out the bridge of the nose — wherever the face “points” with this arrow, that is where the eyes also must point;
- A straight-out gaze occurs when you stand with good posture in front of the mirror and look directly at your own pupils;
- A straight-out gaze aims the line of sight the same direction that the side pieces on a pair of glasses aim;
- A straight-out gaze does not direct the line of sight horizontally to the left or right of straight ahead;
- A straight-out gaze occurs when a person standing on the shore with good posture looks at the far line of the sea’s horizon, as this matches the skull line across the head and the pupils also join this far-horizon line;
- A straight-out gaze occurs when a pirate uses a long telescope with good posture to scan the distant horizon for booty;
- When the eyeballs are inside the ball, the forehead will necessarily be higher than the chin with a straight-out gaze, but

the face as a whole must aim at the ball and the eyeballs aim straight out so that the lines of sight look where the face aims;

- When the eyeballs are inside the ball but the face is tilted forehead-up too much, the gaze is again directed down the cheeks and is not straight out so that the face aims beyond the ball but the gaze looks down the face at the ball;
- The frequent claim that positioning the eyeballs inside the ball “causes” golfers to mis-perceive the target to the outside of its true location is not accurate, as a straight-out gaze with a simple head swivel works fine from this location;
- Instructors often claim that positioning the eyeballs beyond the ball “causes” golfers to see the target to the inside of its true location, but this is not accurate: so long as the gaze is directed straight out of the face and the face aims back inward at the ball, a simple rotation of the head sends the line of sight straight sideways along the ground with no misdirection (but this is not a good posture for reasons of inner ear balance and overly flexed neck muscles).

The old “rule” of the 1950s and 1960s had two parts: 1) set the eyeballs directly above the golf ball, and 2) set the back of the head and face “flat” to the surface, but this “rule” missed the essential element of setting the gaze perpendicular out of the face; although the 2-part rule achieves the perpendicular gaze, it is ONLY the perpendicular gaze that matters. At left, Jim Flick illustrates the “flat head” with eyes directly above



ball and the proper head turn to “face” down the line. At right, Jerry Barber illustrates the correct old rule that unknowingly results in a perpendicular gaze, which aims the line of sight the same way the side pieces on his glasses aim and also where his face aims.

Placing the eyeballs inside the golf ball is still okay so long as the gaze is perpendicular out of the face, and the face is aimed at the ball along with the gaze direction of the line of sight.

On the other hand, simply placing the eyeballs directly above the golf ball is today mistakenly thought to be the “rule.” But it is entirely possible and in fact common for today’s golfers to set the eyeballs above the ball and still face beyond the ball and direct the gaze down the cheek as if peering down thru bifocals — a sure recipe for misperceiving the target location.



Placing the left hand straight across the face just BELOW the pupils in a salute gesture prevents gazing down the face; using the hand this way and then bending the face until the ball appears on the top side of this hand results in a straight-out gaze;

A straight-out gaze always has the line of sight of each eye transit thru glasses lenses in exactly one particular spot, which is located sideways from the bridge of the nose about 1.25 inches either direction from the center of the face at the bridge of the nose; if the line of sight does not pass thru exactly this one spot, the eye is not aimed straight out.

If a person with glasses stood in front of a mirror with good posture and gazed straight into their own pupil, the line of sight would transit this one spot; using the mirror to see the pupil behind this spot allows the person to use a red marker to “dot” this special spot; the glasses with a red dot on this spot then serve as a laser such that whatever location shows up as a red dot is one looked at with a straight-out gaze.



Learning aiming with the Argon Laser: use the correct physical procedure for generating accurate aim perceptions and only then light up the laser for feedback as to how well you have done “au naturel”. While using the laser to “find” the correct aim can be useful for soaking in the “look and feel” of straight aim in a square setup, the “au naturel” use is the one that directly teaches how to use the body in the generation of accurate side-on perceptions of where the putter face actually aims.

TRICKS FOR A PROPER HEAD TURN.

Only a proper head turn sends the straight-out gaze in a straight line sideways along the ground. The proper head turn simply rotates the axis of the center of the neck thru the top of the skull without shifting the top of the axis around. If you planted the crown of your head against a wall wearing a ball cap, the button on the cap in a good head swivel would simply spin in place against the wall, and would not slide or drag laterally. The chin in this turn remains the same distance out from the shoulder frame at all times. To practice a good head turn, make a tiny telescope with your right fist and fit it to the right eye so it aims straight out; then find a line on the floor, square up to it, and bend the face and telescope fist together until the line shows up in the small hole; then a proper head turn KEEPS the line on the floor inside the tiny hole the entire turning down the line.

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Chapter 7: Reading the Putt for Target.

SKILL 1: PICKING A TARGET FOR LINE AND DISTANCE.

Green reading is not the same as putt reading. Green reading is assessing the overall situating of the green in the lay of the surrounding terrain, to see how the green as a whole fits into the drainage pattern of the land. Putt reading concerns only the specific contour of the green that may be involved with the putt. Reading the green is a general beginning for reading the putt.

READ THE GREEN AS A WHOLE FROM THE FAIRWAY.



This sort of assessment is best done from the fairway from 100 to 150 yards out. The general pattern of drainage always heads to the lowest area, both low areas locally and in the distance.

So greens generally are situated to drain in the same direction as lakes, ponds, and streams, or thru local ditches or runoff valleys towards distant water (e.g., nearby rivers or the sea).

USE REFERENCES TO VERTICAL OR HORIZONTAL.

The use of references to true vertical (radio antennae, tall buildings or chimneys, or even your





Using island poles and water to see slope of green at TPC Sawgrass # 17.

club shaft held like a plumb line, but not usually trees and often the flagstick is slanted out of plumb) or true horizontals (ponds and lakes) is helpful, but ultimately you need to rely upon your sense of balance, the sense of upright, your visual sense of level, and your sense of where the

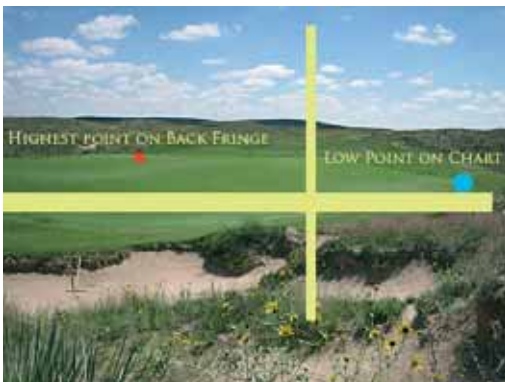
zenith of the sky is located. By assessing the green as a whole in this fashion, you can identify the highest and lowest points on the green, and this will give you a starting point for reading putts.



LOCAL HILLS AND MOUNTAINS CONFUSE SCENERY.

The presence of prominent hills or mountains may confuse the impression of this drainage pattern, especially if the green is not

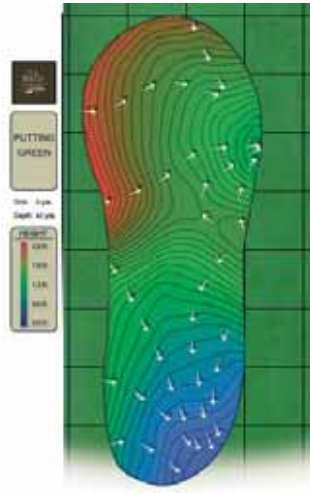
actually continuous with the downward sloping of the most prominent hill, but simply near it as part of a smaller hill.



READ THE STOCK CHART OF THE HIGH FRINGE.

As you approach nearer to the green, you can go to the lowest point and look up into the green to

find the highest point. From here, the back fringe “reads” from left to right like a stock chart, and indicates the highest point. The “fall line” of major drainage flow down the green ought to follow this generalized “fall line” from highest opposite point on fringe to lowest point. The actual fall-line at the cup probably differs.



BEWARE OF LOBED GREENS WITH CATCHMENT BASINS.

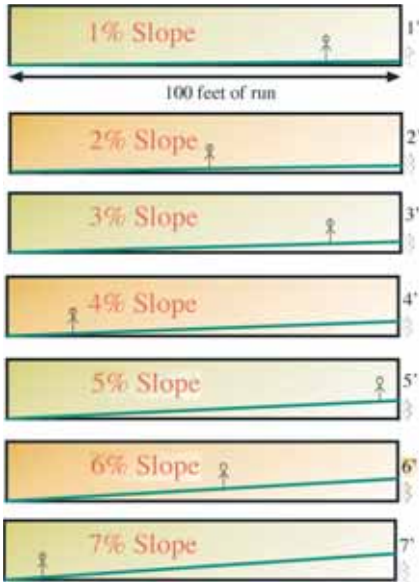
Greens today are sometimes designed with lobes, and these lobes might drain separately, seemingly away from the overall drainage pattern of the terrain. But this is partly illusion. In such cases, the lobe drains to a local catchments basin, where the water is collected in a drain grate and re-routed by pipes back into the dominant flow of the local terrain. Nonetheless, when there are multiple exits for drainage

off the green, these areas have radically different orientation for their fall lines.

This Stracka Design™ green image (left) indicates two drainage lobes with exit points top right and bottom right. The fall lines for each area are in a sense “magnetized” towards the exit points for each drainage lobe. This green divides in the middle into two distinct areas.

ASSESS OVERALL SLOPE AS RISE OVER RUN.

Also, from this vantage point looking up into the green, you can assess the overall slope of the green. In order to drain properly so the turf grass prospers, greens have underground drainage pipes that have to be tilted downhill at least 1 or 2



percent. Slope is either expressed as an angle in degrees or as a percentage of rise over run. Normally, green slope is expressed as a percentage. For example, if the green runs 100 feet from low to high, and rises over that distance by 3 feet, the slope is 3 percent. If you squatted at the low point and stood your putter upright in front of you, and looked level across the top of the handle like a surveyor, you should site the top fringe 100 feet away. That's because the

putter is about 3 feet in length. A 2 percent slope shows the top fringe only two feet high up the shaft. If the available green provides only 50 feet from ball to far uphill fringe, then the distance up the shaft is doubled to indicate slope percentage: a 1 foot rise over 50 feet is a 2% slope.

PERCEIVING ELEVATION CHANGE FROM BALL TO HOLE.

In addition to slope, the golfer needs a bit more precise perception of the elevation differences between the ball and the hole (and major hills or valleys in between). The brain implicitly uses the sense of upright posture and balance to compare the angle of vision from ball to hole at different elevations compared to the angle the vision would have if there were no elevation difference. This means that the position and distance one stands behind the ball or the hole or stands beside the line matters to the regularity and consistency with which the brain gathers this sort of information.

A good perspective behind the ball for perceiving elevation differences is “not too close” to the ball, but far enough back so that the golfer takes in both the ball and hole with a still head and unmoving eyes. Then the golfer can shift the vision from ball to hole either with the head and neck or only the eyeballs, allowing the lenses to change shape for the different distances as well. Standing too close to the ball makes the golfer lose sight of the ball or the hole while changing the head and eyes to look at one or the other.

Standing to the side of the putt, it helps if the golfer positions himself on the low side of the putt and also at the apex of an equilateral triangle with vertices at the ball, the hole, and the golfer’s feet. From this position, the line from the eyes to the ball equals the line from the eyes to the hole, and both equal the distance of the putt from ball to hole on a direct line. This perspective also generally allows seeing both the ball and hole simultaneously, without the need to lose sight of one to see the other.

Standing behind the hole to perceive elevation differences usually requires standing back from the hole as was helpful standing behind the ball.

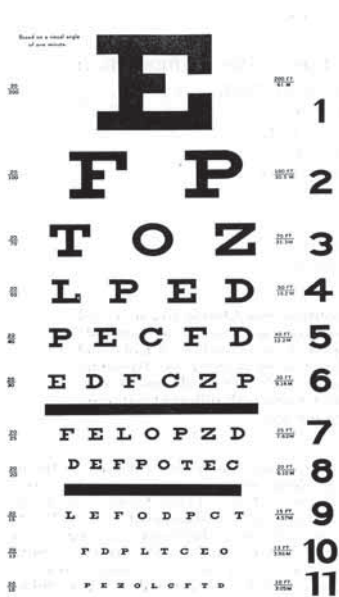
There is a significant difference between looking uphill and looking downhill, as more information is available visually looking uphill (see below for more). Hence, perceiving elevation differences is best from the low side, whether that is below the ball (uphill putt) or below the hole (downhill putt). As a general rule, ANYTIME the ball ends up rolling to a hole location at a lower elevation on the green, the golfer is well served to spend time below the hole reading the putt.

Finally, the golfer reads the elevation change by walking beside the putt from ball to hole and back. The sense of walking uphill or downhill is sufficiently acute that this information

is a good gauge of gross uphill-downhill issues as well as the extent of the elevation change.

PERCEIVING GREEN SURFACE CONTOUR.

As a matter of perception, the three factors that determine the curvature of the putt — slope, green speed, and ball speed — entail distinct processes and facilities for perception. Perceiving slope, tilt or undulation is a matter of how the figure-ground detail of the surface diminishes with distance, as appears when one scans from near to far across a checked floor. For the floor, the “detail” that matters is the square check. But on the green, the “detail” that matters is mostly the grass blade, which is typically no more than 1/8th inch tall and much less than that in width.



The first consideration for perceiving surface is visual acuity. Typically, the normal human eye can easily discriminate the left edge from the right edge of a blade of grass near the feet, as the distance from eye to grass blade is around 5-6 feet. However, as the distance increases across the green to “far,” eventually the golfer’s ability to discriminate one grass blade from another dissipates entirely, and the surface becomes a uniform sea of color lacking detail. At this distance, the golfer is using features other than surface detail to perceive slant and slope and contour.

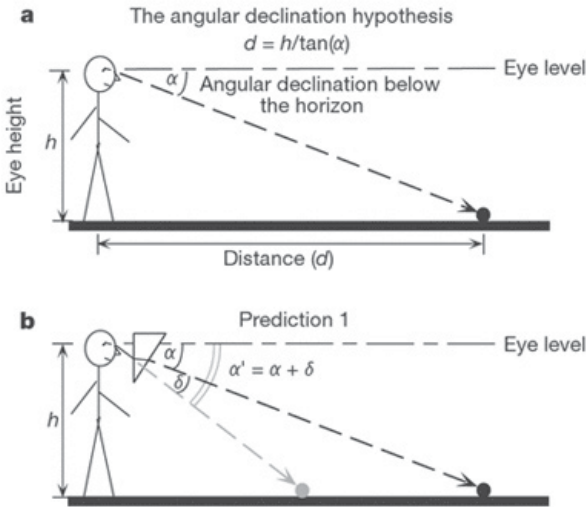
While the brain generally “fills in the details” and “extrapolates” information from one area to another when reasonable in experience to do so, it is always a good idea to get a closer examination of “far” areas by walking over to them, to bring the pattern of detail change back into the mix.

To see the truth of this limit to visual acuity, one needs only read a newspaper or telephone book and look at the letter “i”. The ability to discriminate the stem from the dot depends upon the size of the gap and how far away the gap is seen. As the person extends the “i” away from the face, there comes a point where the “i” transforms into an “l” shape, as the gap “disappears”. On the green, the gap from one grass blade to the next typically disappears in 20-30 feet, which is the range for most people where detail is still available. In fact, the main golfing benefit of LASIK surgery (laser reshaping of the cornea in order to sharpen up distant acuity) is to extend the range in which a golfer sees detail. On the green, this gives the golfer a much better ability to relate detail over a wider range of near and far, and this seems for a while like a fantastic new vision of greens and breaks. However, the golfer then grows accustomed to the new vision and the “honeymoon” effect lessens.

The second perceptual issue is the pattern of change of the detail near to far. If the surface is flat and level like a floor, the detail diminishes in size with gradual regularity, as commonly understood. But when the surface tilts up towards the golfer, the detail diminishes less, such that if the tilt were enough to make the surface like a wall instead of a floor, the detail would not appear different at all from the “near” at the bottom of the wall to the “far” at the top of the wall. On the other hand, when the surface tilts down away from the golfer, the detail nearly disappears entirely, so looking downhill at the surface is not a good perspective



for reading contour. Hence, looking “up” into the green like reading a book tilted up to the face is the best perspective for seeing contour detail.



The third perceptual matter for seeing contour or undulation is the height of the eyes above the surface. The higher the eyes, the more downward the angle to near surface and the less downward the

angle to far surface. The more downward the angle, the less the surface detail diminishes near to far. This means that when the golfer crouches low to read the surface, he is mostly influencing his perception of near surface.

The fourth issue is using senses other than vision, such as the sense of straight ahead, the sense of straight up, and the sensations of surface undulation and slope that come thru the feet and the human balance system of the inner ears. Using the feet to sense surface shape is generally enhanced by good posture and level alignment of vision with the far horizon (and hence gravity).

PERCEIVING GREEN SPEED.

The senses for perceiving green speed are of course visual in the main, but include the senses of the feet and the nose as well. Green speed depends upon moisture in the grass blades and on the surface. Moist blades are fatter than dry blades, so moist blades are slower since offering greater resistance to

roll. Perceiving this moisture level in partly knowing when the green was last irrigated, how these greens drain, how the temperature and sunshine or clouds and humidity and wind affect evaporation rates, how moisture is expressed in the color of the grass, and how moisture smells. For smell, the human nose detects molecules in the air, and the smell of the grass consists in molecules carried to the nose by moisture in the air. For this reason, freshly mown greens in the dewy morning with a slight breeze smell quite a bit more than arid greens in an environment without much humidity or wind. A fresh smell of a green is a sign that the green may be a bit slower than expected, even if recently mown.

Occasionally, the fact that the area right near the hole receives the great concentration of foot traffic in players' retrieving their balls after putting out means that the speed right near the green may be quicker than the rest of the putt. A close examination of this area includes a check for this subtle danger.

"Also, develop the habit of looking around the hole when you read longer putts. The grass around the cup is usually a little firmer than the rest of the green, because of players stepping to retrieve balls from the cup. This can make the area around the hole faster than the rest of the green. Take this into consideration when gauging the distance." — Crenshaw, Ben (1980). Putting errors you make: Read the distance, *Golf Mag.*, 22(7), Jul 1980, 48.

"Laddie, just look around the hole. That's the important spot." — Bobby Locke, quoted in Floyd, Raymond & Dennis, Larry (1992). From Sixty Yards In: How to Master Golf's Short Game (New York: Harper Collins, 1992), 62.

"What should be done, as Bobby Locke points out, is to examine critically the area about 3 feet around the hole. Here is the area where the speed of the ball diminishes rapidly; hence the greatest break will occur in this area. It is often the subtle break at the very end of a 15-foot putt which will be the deciding factor — provided the speed was properly given in the first place." — Golf Magazine (1973). *Golf Magazine's Handbook of Putting* (New York: Harper & Row, 1973; London: Pelham, 1975), 97.

VISUALIZING ROLLING SPEED OF THE BALL.

The perception of the rolling speed of the ball across different areas of the green, and especially the final area at the hole, is mostly built up by implicit experience over time playing golf. But the skilled golfer deliberately and explicitly soaks up this information by carefully observing the real-time motion of the roll of putts, especially at the final roll-out. The final swiveling of the head from ball to target, if done as if watching a “ghost ball” in the visualization roll with the same speed the anticipated putt should have, expresses itself into the brain via the pacing of the neck turn targetward. This physical expression of the pace of the putt and its pattern of slowing at the hole in the usual roll-out is used by the brain in calibrating the force of the stroke by setting the size of the backstroke. So this final act of perceiving distance requires an accurate understanding of how rolling balls start fast and gradually slow and come to a stop over different green speeds and uphill-downhill situations.



The old two-colored Ping balls of the 1970s are nice training aids for watching the end roll-out pattern of putts. As the ball initially rolls fast, the two colors blend into a single hue, but as the ball's roll slows near the hole, the ball's two colors separate and the ball at left would appear to flicker orange / yellow at a slowing rate until it stops.

OTHER PERCEPTION ISSUES FOR READING PUTTS.

While initially placing the ball at the marker, the golfer should note how a direct line from ball to center of hole divides the green into high and low sides, as this “direct line” or “base line” makes the difference between high and low sides clearer than otherwise and easier to perceive in cases of doubt.

In visualizing the arrival of the ball into the cup over the final few feet, the golfer might try standing a few paces behind the hole looking back towards the ball's address position. This perspective frequently reveals slightly less break than other perspectives, and constrains the focus to the critical area. This perspective also gives the golfer a good sense of the maximum uphill curvature of the total putt path, and this aids in establishing the start line. The golfer should be careful to visualize the arrival of the ball into this perspective in its anticipated real-time delivery pattern.

Next, the golfer examines the contour between the ball and the hole for a sense of how to manage the intervening section in a manner that results in the appropriate roll of the ball into the final area at the hole. This perspective is frequently just below the hole and walking back to the ball on the low side. The golfer can use his sense of balance and weight distribution in the feet to read subtle contours in the green. Standing while facing straight uphill, the feet will have equal weight distribution left and right with no extra pressure to the outside or inside edges of the feet, and the heels will catch more of the weight than the balls of the feet. Facing downhill, the weight distribution heel-toe is reversed, with the balls of the feet catching the downhill weight. Facing sideways along slope, the downhill edges of the feet and the downhill foot catch more weight. The golfer also uses the feet to assess elevation changes when walking between ball and hole.

Returning to the ball walking along the low side, looking uphill into the green so as to see more detail (as in "reading a book" rather than looking downhill on an angle that scarce reveals surface detail), the golfer continues to visualize the forthcoming putt in real-time speed, noting particularly how the path of the putt runs in reverse back to the ball. The final straightness of the putt path nearest the ball indicate the aim line and start line for the putt. The "target" spot or ghost hole will be located on the fall-line above the hole where this start

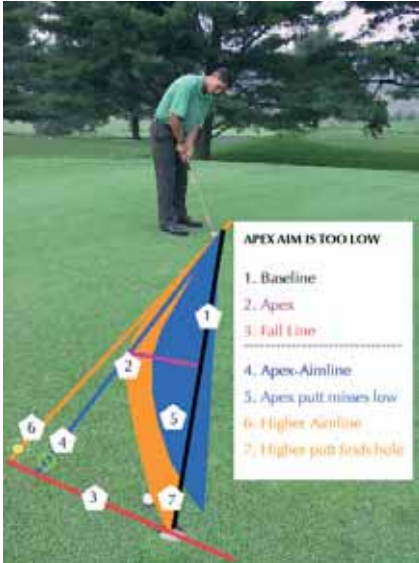
line intersects the fall-line, absent some other intervening break.

In the event there is intervening break as occurs when the ball crosses a “shoulder” feature near a greenside bunker, or rolls down and back up through a trough, or climbs a tier somewhat sideways, the outcome of the putt still is determined by what happens in the last 3-4 feet of the path into the cup. Because of this, the golfer plans the multiple-breaking putt backwards from the hole, separately treating each identifiable feature in terms of exit from feature and then entrance into feature, with appropriate energy. For example, for a putt downhill over a tier to a hole several feet past the roll-out range of the bottom of the tier, the golfer should read the final section of the putt from behind the hole first to see what specific fall-line down the tier will deliver the ball into the final section on the necessary path with its real speed. This indicates the point of exit off the tier, and the fall-line of the tier by reverse imagining shows the entry point at the top edge of the tier, and this handles the intervening feature. The putt is then planned to deliver the ball over the top edge with appropriate pace to make the rest of the putt go as envisioned.

FIND STRAIGHT START LINE FOR THE CURVING PATH.

When this putt path returns to the ball, it has to come squarely into the face aim. If it does, then you will start the ball off straight from the face every single time, start the ball off high enough to stay on the upper side of the “hump” of the break as the path curves into the cup, and aim higher than the “apex” of the path.

THE “APEX” IS TOO LOW AS AN AIM POINT.



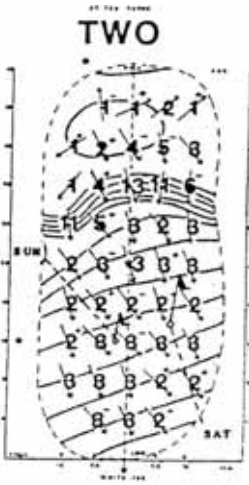
The “apex” is where the curve of the putt is farthest above a direct line from ball to hole. You cannot aim at the “apex”, contrary to what thousands of golfers advise, because this is where the path of the ball becomes parallel to the direct line from ball to hole. The start line cannot “parallel” the base line from ball to hole, and has to be aimed higher up from the base line. Consequently, the start line always has to aim higher than the “apex”.

FIND THE FALL LINE STRAIGHT UPHILL THRU CUP.

The fall line is the ONLY straight-uphill and straight-downhill putt that runs thru a hole in any section of the green whose slope around the hole can be characterized as “flat but tilted” as opposed to “flat and level” or “undulating”. Every location on the green has only one fall line as a permanent feature of the surface. Whenever the hole is located in a specific spot, the fall line for that spot governs breaks into that hole at the end of the putt. Although intervening fall lines along the total putt path certainly play a role as well, in the final outcome the last fall line is determinative. Fortunately, almost all pin locations end up on areas of the green that fit this characterization (flat but tilted), usually out to about 3-10 feet in radius.

The fall line is perpendicular to the usual “contour line”, which connects equal-elevation points. Hence, the fall line “runs down” from one contour line to another and indicates the true direction of slope in space. Generally speaking, as the

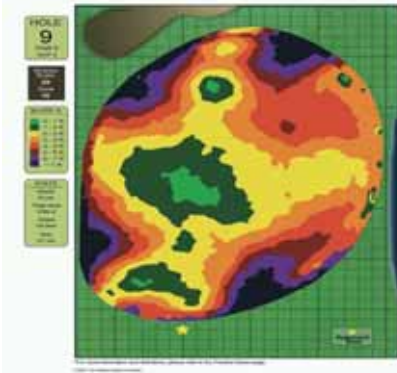
green surface is scanned from one side to another across an area, the fall lines are seen to change direction gradually and smoothly, as a result of the basic smoothness of green surfaces.



This image of the second green at Carswell Airforce Base in Texas is from HA Templeton's *Vector Putting* (page 100), and shows the contour lines as well as fall lines (the numerals indicate slope percentage and the small arrows indicate downhill for the fall lines). A "tier" is evident that divides the front from the rear areas of the green. In this case, the pin is located on the lower area where the slope is 3 percent but the local fall lines are generally similar in their 10 o'clock to 4 o'clock directional orientation, which indicates "flatness" for the area around the hole.

Professional caddies keep course "yardage" books that contain significantly more information about how to play the holes, including maps of the shape and contour of the greens. These green maps are outlines of the shape and dimensions of the green with general levels and lobes marked, and the essential fall lines drawn in.

These Stracka Design™ images of a green's contours areas (below) should be compared with the images of the green displayed with fall lines overlaid on the contour lines (right). The map to the left indicates only areas of equal "slope" and does not indicate up or down, high and low, whereas the map to the right colors high as red and low as blue. On the left, light green indicates a "flat and level" area. Also on the left, the areas where the color remains the same indicates areas without big changes in slope, so these areas can be characterized as reasonably "flat but tilted" or "flat and level." (In the right map, near the two bunkers at left, the green is shaped to pre-



vent water running thru the bunkers and washing out the sand every time it rains. This is a common feature of greens with nearby greenside bunkers. The “red” area in this map nearest the bunkers at the 10 o’clock position of the green indicates a “shoulder” that projects onto the surface and influences break in this part of the green.) [For more, see www.stracka.com.]

To better understand the fall line, consider this surface area around the hole as if it were a CD disk with the perimeter or rim of the disk at the far radius of where the area starts to become “un-flat”. If the green were “flat and level, not tilted”, then all points on the rim of the CD would be at the same elevation, as if the CD were laid flat on a level counter. But whenever the CD is tilted in space in any manner, then one and only one point on the rim is higher than all the others. Finding this highest point on the rim of the hole itself shows the fall line from there down thru the center of the cup and thru the opposite lowest point on the rim of the hole. If the “CD” of this area were a clock face, then the fall line is the 6-12 line, and perceiving its correct orientation is the issue.



The golfer should stand below the hole and generally look to the high side as known from the overall slope of the green in the surrounding terrain, but then focus solely on the area

around the hole. The fall line will generally not be quite the same as the “overall” slope, but will be determined by the specific local surface contour.

Picking out the best guess of the highest spot on the rim is harder with mild slope and easier with severe slope. The highest point is the one at the rim that is closest to the golfer’s eyes and face, given where the golfer is standing below the hole with his feet, so a mild slope makes little difference across the rim bottom to top with the feet, whereas a severe slope makes the difference in points on the rim bottom to top more pronounced, with the top “noticeably” closer to the face and eyes than it should be if the green were level.



A second way to perceive the correct orientation of the fall line is to “see” the axis of tilt of the “CD” area, which corresponds on a clock face to seeing the correct orientation on the surface of the 3-9 line. Along the axis of tilt, all points are the SAME elevation, and all points above the axis are higher, and all points below the axis are lower. But directly along the axis to the left and right of the hole when looking up the true fall line, the surface is the same distance down from the eyes and body. Perceiving

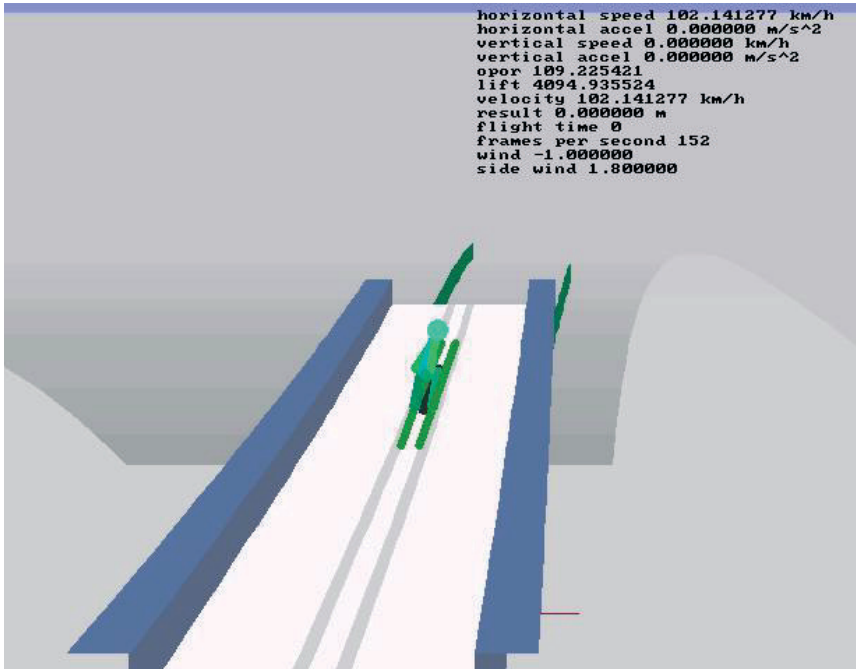


this axis seems to work better if approached more in physical or kinesthetic terms than in simply visual terms. That is, the following analogies seem helpful because reliant upon more total-body perception of the body in action, as opposed to mere visual sensing:

1. View the line uphill thru the cup as if it were a “ski jump ramp” at the end, and the golfer is skiing down the ramp to jump straight off and up at the end of the ramp — any twist in

the golfer's final approach will be disastrous, as only "straight off and up" is relatively safe. The correct left-right orientation of the body on such a ramp squares the direction of the ski jumper to the line of the ramp. Similarly, orienting the body left-right while facing uphill thru the cup sets the body plane of shoulders parallel to the axis of tilt at the cup.

2. Imagine performing "pushups" on a slanted or sloping flat surface, such as a beach. In this case, the body will naturally



align with the fall line of the beach (either uphill or downhill) and will place the hands to each side where neither hand is higher than the other in order to equalize the weight and share the load of the work evenly with each side of the body.

Looking uphill at the cup in this manner, the golfer can imagine what is definitely NOT the axis of tilt or straight uphill. If, in the manner of a radio operator tuning in an



elusive frequency, the golfer deliberately mis-oriens the hands for example along the 4-to-10 clock face line, with the left hand definitely higher than the right (below L), and then go the opposite direction and mis-orient the hands on the 8-to-2 line with the right hand now higher (below C), this missing process essentially identifies the middle position fairly accurately. The golfer can then “split the difference,” and the hands would then correctly orient to the 3-to-9 line (below R).

Having perceived the fall line first one way (highest point on rim) and a second way (axis of tilt), the golfer needs to make



Way Wrong

Equally Wrong

Just Right

sure the two coincide in a perpendicular meeting — otherwise, one or both are incorrect. My experience is that the one most likely off is the highest point on the rim. When the two do not meet perpendicularly, I look at whether adjusting the highest point to match up with the axis of tilt results in something satisfying and acceptable. If so, I’m done.

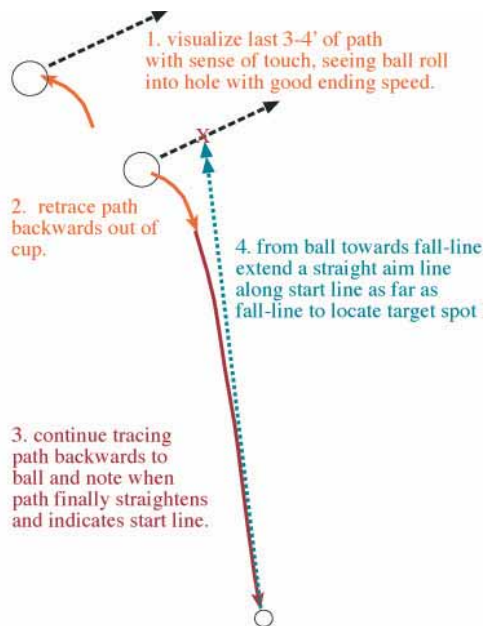
In my experience, people are not as good at correctly identifying the fall line as they suppose, and need some basic experience attempting to perceive fall lines and then TEST to see how accurate the perceptions really are. A simple test is to place a ball at the supposed 6 position about 5-10 feet out and then putt dead straight at the center of the hole with the usual delivery speed, and then wait to see whether the ball breaks any — no break indicates the 6 is on the fall line; break

to the left or 9 side indicates the fall line is closer to the 7-to-1 orientation; break to the right or 3 side indicates the fall line is closer to the 5-to-11 orientation. Move the starting position of the ball in the same direction as the break and putt straight again until the break disappears and the ball rolls straight all the way into the cup.

After some experience focusing on these perceptions, finding the fall lines accurately becomes much easier and swifter. Walking onto the green, a golfer experienced at how to perceive the fall line requires only a few brief moments' attention, and can then get on with reading the putt.

USE TARGET SPOT ALWAYS ON THE FALL LINE HIGH.

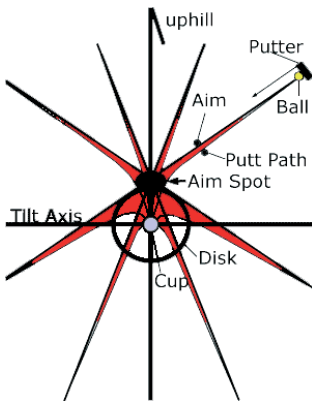
The correct start line is always the same as when the path coming back to the ball at your feet finally straightens out. Extending this start line over the back of the hump until it reaches a point on the fall line, you can use that point as the target spot for targeting both line and distance. Aim the face there, setup square to the face, and putt straight at this point with good touch, and let the breaking of the ball into the cup take care of itself. The "imaginary" straight putt at the target is "as if" the putt would run straight on flat, level surface (like a putt-putt matt) from the ball to the target spot, where a "ghost hole" is centered, and the intention is to deliver the ball straight into this "ghost hole"



Once target spot is located, aim straight at this target and putt as far as target as if the putt were straight and level.

with the usual delivery speed.

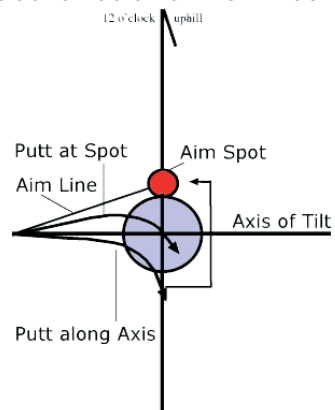
This approach combines line and touch so that the touch used to visualize the break to begin with is the same touch used to execute the imaginary straight putt, and is also the correct touch for the real curving or breaking path to deliver the ball into the real hole with perfect speed. As a bonus, using the fall line target spot in this manner, there is no issue of what touch to use for any breaking putt: use the same sense of touch you always use, as that is the sense that shows you the break to begin with and that is the only touch or pace that will roll the ball with appropriate energy along that same visualized path.



SEE THE SPIDER AT ANY LOCATION ON THE GREEN.

Because of the above, any location on the green can be seen as a hole location that has the look of a “spider.” The spider body is the hole, and the spider head is on the fall line a certain distance uphill from the center of the hole (usually but not always outside the upper lip, but sometimes inside the hole). By using the head of the spider as an aim point, you can simplify all breaking putts to one aim spot, at least as far as this final “flat but tilted” section of the putt.

To find out how far up the fall line the head of the spider is located, assess the length of your putt and then walk to a location on the axis of tilt that same distance. The axis of tilt is perpendicular to the fall line, so this location is a side-on putt. Imagine putting straight at the center of the



hole with your usual great touch, knowing that the ball will curl downhill. Then assess mentally just where this imaginary “straight” side-on putt would cross the fall line below the hole. That distance — from the crossing point low to the center of the hole — indicates how high up the fall line to locate the head of the spider as an aim spot. For ANY putt at this hole on a circle with the diameter of your putt length, the same head of the spider is the aim spot for the start line, making all breaking putts straight.

The “spider” approach to finding an aim point for a breaking putt is limited by the assumption that the green surface around the hole and between your ball and the hole is flat but tilted. If there is intervening undulation between the ball and the hole (or just significant contour change away from flatness), this approach may not be appropriate. Thankfully, the guidelines for hole placement generally result in the area immediately around the hole being flatish and not too severe in slope, so the spider system often works very well.

Another caveat is that the spider approach to finding an aim spot is not as accurate as reading the putt backwards out of the hole to see the final 2 or 3 feet of the path. While these two methods should in principle indicate only one and the same target spot on the fall-line, since both are reading the same break with the same delivery speed, in practice sometimes the two have a minor difference. The “spider” 3-o’clock estimation is one level abstracted from the actual putt, and the instincts always turn to reality without abstraction. The intuitive visualization of the break over the final three feet or so of the actual putt is the more precise read. Consequently, the spider should be used only as a “ball park” approach, and then graduate to reading the putt backwards out of the hole. If the two methods agree, fine and dandy; but if there is a conflict, the “backwards” method is the one to trust.

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Geoff Mangum (L) working with John Eyre (C) and Chris Hanson (R) at Crosland Heath GC, Yorkshire England.

Chapter 8: Putting Routine.

PURPOSE.

The putting routine has the purpose of structuring the “action” of putting to layer and sequence the perceptual and movement processes in an orderly manner that complements and enhances innate instincts. A secondary purpose is to insulate the golfer from distraction by keeping the focus on performing well “what works and why” thru each stage along the way.

PRE-ROUND PREPARATION.

The routine in the broadest sense includes pre-game preparation, including surveying the course in a practice round or otherwise becoming familiar with approach-shot options and the greens. Professional caddies typically survey greens and sketch out the major contours and the fall-lines at likely pin locations and major contour changes like tiers.

On the day of a round of golf, the pre-round session on the practice green serves the purposes of reacquainting the golfer with the usual tempo, the speed of the green, and the basics of distance control and stroke. A reasonable sequence might include core putts for green speed across level surface as well as uphill and downhill; straight strokes to check stroke dynamics; long lag putts; and a series of short breaking putts.

APPROACH ROUTINE.

The putting routine for a specific hole begins on the tee-box with the management plan for playing the hole, setting up the approach shot on par fours and par fives and then executing the approach shot with a view to leaving a short uphill putt for birdie. This reading the green for purposes of the approach shot clearly implies reading the fall-lie thru the pin location.

From the fairway out at the distance of the approach shot, the golfer assesses the lay of the green as a whole in the surrounding terrain with a view not only to “short side” and trouble and “safe misses,” but also with a view to leaving a close straight uphill putt. This requires knowing the fall line at the pin location for that day, or at

least being able to estimate the fall line from the fairway.



During the walk-up to the green, the putting routine includes carrying the putter to re-familiarize oneself with its heft.

Harvey Penick advised his students to carry the putter to the green in the left hand, as he viewed the left hand as playing the more important role of the two during putting. In addition, the golfer needs to survey the general lay of the surrounding terrain in which the green is seated, as the weathering of the local terrain has defined its general drainage patterns and the directions of flow of water along fall-lines.

While doing so, the golfer can also look for references to true vertical and horizontal, as an aid to accurately assessing green surface, including the edges of brick structures, communication towers, and the surface of lakes or ponds. The flags in greens usually do not indicate true vertical as the initial setting of the cup in the morning, usage during the day by previous players, and the wind usually result in flags not extending plumb out of the cups.

The golfer also needs to be mindful of good posture while walking towards the green, with good skeletal posture and even balance, eyes level with the horizon, and the inner ear sensible of the zenith of the dome of the sky overhead. Great

putters have great posture — otherwise, golfers have difficulty perceiving the important cues for surface contour.

While walking into the green, the golfer should notice the lowest point on the edge of the green, the green's overall drainage pattern, and its highest point. This general sense of the overall slope of the green as a whole informs but does not determine the more critical perception of the orientation of the fall-line thru the cup. Finally, as the golfer walks up to the green, observation of the visual looming of the green as the golfer gets closer is another important perceptual source for the size and contour of the green.

ON THE GREEN ROUTINE.

Once the golfer arrives at the green, the time has come to “slow down” the brain and body when crossing the fringe onto the special “sanctuary” of the “dance floor of golf.” The golfer needs calm attention and easy motions while enjoying the here and now of the outdoors, the course, and the game.

No green is ever a negative problem for a great putter, but is always something that aids the great putter more so than other golfers. So the golfer enjoys the opportunity to use his skills to advantage.

Marking the ball, the golfer foresees a good putt. The golfer watches the actions of others as they walk the green, thereby gaining additional sense of the space and shape of the green. The known size of the golfers is compared in the brain to the apparent images of the golfers as these change with the distance as the golfers walk about. The brain uses this information to “map” the space of the green. (Hoffman, 2000).

Watching the putts of other players gives more information about the surface contour and speed, even if the actual stroke of the other player is somewhat in doubt. The end roll-out of the putt will always indicate how firmly the other player

putted, and the observing golfer then filters the information from this putt in light of the speed or pace the other player employed. All of these observations are part of reading and planning the putt.

READING ROUTINE.

Once the golfer starts reading the putt in turn, the golfer's focus narrows to only that part of the green potentially involved in the putt. The primary objective is to appreciate the surface nearest the hole in terms of steepness of slope, subtlety of undulation, grass speed and orientation of the fall-line. By this point, the golfer should already have a pretty precise notion of the fall-line. Bobby Locke, for example, would examine the three feet around the hole in detail as the most important phase of reading putts, imagining and visualizing the final curvature of the anticipated putt into the hole. Visualizing the arrival of the ball with the usual sense of delivery speed to all holes, the golfer is enabled accurately to predict how slope, green speed, and rolling speed of ball combine in expressing the actual curvature of the break into the cup.

ROUTINE FOR SENSING GREEN SPEED.

Green speed may vary from green to green and over time from what speed the golfer faced earlier, so a fresh sensing of green speed for every green is advisable. As discussed above, when initially arriving at the green and while on the green, the golfer assesses whether the speed of the green matches expectations. Indeed, the golfer earlier should watch the response on the green of the approach shot to get a sense of green speed as well. The golfer notes whether the green is exposed to sun and wind or is in shadow sheltered from wind and sun, whether the green has a lush verdant color in the grass or the grass is more tawny and straw-colored, and whether the green surface feels floor-like as tight and packed or feels somewhat spongy and resilient. At the end of the process, the golfer has a starting line and at least the first target (single-break putts), and an

appreciation of what needs to happen at the end of the putt for success. The routine then shifts to aiming the putter at the target and final preparations for pulling the trigger.

ROUTINE FOR PERCEIVING GREEN CONTOUR.

The golfer should stand behind the ball a sufficient distance and then approach the ball for a crouching perspective. Then the golfer should walk the putt along the low side, pausing at a point that “triangulates” the length of putt with the distances back to the ball and to the hole. Then the golfer should stand behind the hole and visualize how the ball would arrive in the real-time rolling of the usual delivery pace for that golfer’s touch. Using the “retracing process” from the final 2-3 feet, the golfer identifies a target spot on the fall line. Then the golfer proceeds back to the ball along the low side and retakes a position behind the ball to recapture these perceptions from this fresh perspective. At this point, the golfer should have in mind a specific target on the fall line, and a starting line away from the ball that coincides with what was perceived near the hole.

ROUTINE FOR READING ELEVATION CHANGE.

Reading elevation change is probably best focused upon while waiting turn to play. After it becomes the golfer’s turn, he or she notes elevation change along with the routine positionings and movements used in reading the contour. Elevation change may be noticed best occasionally from the low side about half-way between ball and hole. Generally, looking uphill to one end or the other gives better visual information than looking downhill.

AIMING ROUTINE.

The aiming routine assumes that the distant target is well-defined. The golfer follows a three-phase routine that 1) sees the straight line from ball to target for the purpose of anchoring the line with a spot shortly in front of the ball on this line; 2) plac-

ing the putter head behind the ball and squaring it up to the aiming spot directly in front of the ball; and 3) then setting up to the putter as aimed and checking the aim of the putter face from beside the ball. When the beside-the-ball checking of the aim agrees with the behind-the-ball aim, the routine shifts from the reading and aiming process to the stroke and distance control process. All questions of whether the putter face is well aimed are abandoned in favor of total commitment to executing the putt that the aim of the putter face requires.



Sighting the line from ball to target spot on fall-line, identifying aim spot at end of aiming "T"s stem, and walking the line into ball in order to aim the putter face down the stem.

SETUP ROUTINE.

The setup with respect to the aimed and waiting putter follows the progression of hanging the arms and hands naturally; walking the hands out to the handle without reaching the forearms away from or in towards the body to “take hold” of the handle; positioning the throat-line and shoulders; settling the feet in a comfortable, balanced, and stable stance; and setting the head and neck and eyes in proper posture for the final checking of the aim of the putter face and for the head swivel targetward that generates the final distance calibration for the backstroke. The golfer then allows the rear hand to swing free off the handle and observes whether it swings only sideways, indicating a good distance back from the ball for making a neutral shoulder stroke.



AIMING CHECK AND DISTANCE HEAD-TURN.

At this point, the golfer is transitioning in the "action" from general setup procedure into stroking movement. While strictly speaking head orientation is not required for the stroke itself, a specific head-eye posture IS required to generate accurate perceptions of where in fact the putter face aims and also in the generation of accurate distance information from the turning of the head to face down the line as far as the target.

For this reason, the golfer now sets the gaze direction of the eyeballs straight and level out of the face and bends the head and neck and upper back until this straight-gaze is "facing" directly at the ball and sweetspot of the putter, taking care that this setting of the head and neck does not alter the matching of the throat-line and shoulder frame to the aimed putter face. If the golfer's eyes are directly above the ball, then the back of the head will necessarily be "flat" with the axis of the neck parallel to the surface. If the eyes are slightly inside the ball, the golfer's face will be slightly tilted up with forehead higher off the ground than the chin and there will be an appropriately slight up-angle in the axis of the neck. This does not matter so long as the gaze remains straight out. The flaw to be avoided is setting the face and head on a slight up-tilt and THEN allowing the eyeballs to shift to a slightly downward gaze. The eyeballs in all events should remain aimed straight perpendicularly out of the face, with the face itself aimed at the ball so that then the line of sight also "looks at" the ball.

Finally, positioning the eyes out beyond the ball requires a head posture that "looks back in" towards the body with the face tilted forehead-down. Golfers should avoid this posture for two reasons: 1) this posture of the inner ear is disturbing to the sense of spatial awareness, and 2) the tightness of the overly flexed neck plays havoc with an on-plane swiveling of the axis of the neck in turning the head and face and gaze targetward. The choice is between eyes inside the ball or eyes above the ball, and the golfer's neck is never bent further over

than parallel to the surface. This procedure sets the head, eyes, shoulders, arms and hands to the aimed putter face.



Setting up to the putter face as aimed down the stem, while also making sure that direction of gaze is straight out and level and that throat line matches leading edge of putter face, then “facing” ball and rotating head like an “apple on a stick” to run line of sight down same line putter face aims, to verify that putter actually aims at the target spot. (The use of the “fist telescope” is only included for illustration of the gaze.)

STROKE ROUTINE.

With the final targeting complete, and the setup fully adopted, the golfer is primed to execute the stroke movement. There is no further call for problem solving, no further role for thinking, and no help to be found in negative thoughts or anxiety or doubt. This state of affairs creates a clear boundary between everything that has gone on before in the “action” of the putt and the making of the stroke. A stroke motion is a physical action and not a visual or mental action. Once the golfer reaches this point, he has the line of the putt (the putter face itself aims down this line and none other) and is also primed for distance or touch by his targeting process and his resolve to use the regular tempo. Moreover, the golfer cannot control anything other than the matter of stroking the ball straight, and once the ball exits the view at the feet, there is nothing to be done other than accepting the result good or bad.

This being the case, the mind-set of the golfer is simply: “make a beautiful stroke,” the same as always, with good tempo and the usual touch, rolling the ball straight out of the setup down the line the putter face aims, as always.

If there is any attention to the details of how to make the stroke, this is confined to remembering to start the stroke with the lead shoulder shoving the putter head back from address, the anchoring of the backstroke with the lead hip, the fixing of the throat-line square to the target line thru impact, the allowing the momentum of the putting stroke to define its own trajectory thru impact and upwards slightly beneath the fixed pivot, and the feel of “nothing changing” in the hands and wrists and arms as the golfer “rides” the down-and-thru stroke.



Academics and sports psychologists who counsel “target consciousness” or external focus during the making of the stroke (e.g., Wulf, 2007) seem unfamiliar with the great benefit of knowing what works and why in terms of specific stroke dynamics. Perhaps more importantly, there is not a necessary, exclusive choice between target focus versus stroke movement focus, between external focus versus internal focus, or between outcome focus versus process focus. It’s a convenient fiction useful for academic purposes, but the brain is not that strictly divided during “action”.

The usual cant about target focus comes dressed in exclusively mental-imagery clothing and has a decidedly threatening suggestion that unless the prescription is followed religiously, the golfer will somehow be disabled from great putting. In fact, target awareness and “consciousness” is much more a physically embodied expression that builds in the aiming of the putter face and in the setting up of the body and the final targeting actions. The notion that a mental image of the target is the ONLY or the MOST EFFECTIVE way to promote a successful stroke is, frankly, nonsense. The important “perception-for-action” is predominantly a physical connection between body and target via the action that connects them. Trying to “focus” only on the external or the target dissects this integrated connectivity of body-target in space.

The truth is that everything the golfer needs for target awareness in his action is available in the view at his feet and embodied in his posture. The body as a whole, primed for the action of the stroke, incorporates all there is to know about where the target is located. Focused intentionality keeps this proprioceptive and motoric sense of target vivid, and it is decidedly more potent and effective than anything by way of mental imagery. Moreover, mental imagery depends quite a bit on variables of perspective and the metric or topology of the individual’s imagery in relation to the actual situation, whereas

the motoric relationship in comparison is distinct and relatively stable. (Berthoz, 2000; Jeannerod, 2006).

At this point, the golfer could dispense entirely with everything above the neck and still make a beautiful stroke and sink the putt. This is why putting with eyes closed works well. Mental imagery may or may not be helpful for a specific golfer, but in any event should not be used to the exclusion of making a beautiful stroke in a purely physical sense.

In pulling the trigger, simply putt straight with smooth tempo.

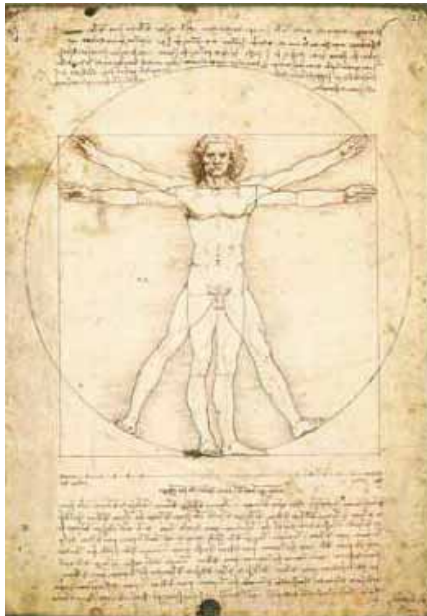


CONCLUSION

With good instinctive touch as the basis for putting, a simple approach to finding an aim spot as a target for both line and distance, aiming the putter face and body at the target, and then putting straight away from the putter face and straight out of the setup with good touch, is about as simple as it gets. This makes putting very intuitive, instinctive, and simple — not a lot of mental baggage when the pressure is on, more fun, and a higher level of play with the emphasis rightly on scoring.

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Chapter 9: Synthesis of the Four Skills

The four skills of putting are interrelated in the instinctive action in subtle and deep ways. Timing appears to be the most important aspect that relates touch to reading and touch to stroke dynamics. The perceptions in aiming and generating distance control rely upon the stability of this timing as well. Below is a short, executive summary of the instinctive processes of the four skills for optimal putting. The recommended setup with its nuances of muscle tone and activation patterns and biomechanics is designed to enhanced the overlapping functions of stroke, targeting and aiming for line and distance, and touch. In the final analysis, instinctive putting is simply “look and putt” in the same sense that a Bengal tiger “looks and jumps” from the ground onto a large branch in the jungle tree. Efficient, non-conscious, accurate, repeatable. Golf instructors just like taking the long way home.

1. Read the putt for target.

Find the correct orientation of the straight uphill “fall-line” at the hole perceiving the highest point on the rim (6-12 on clock) plus level left-right axis of tilt (3-9 line); use the usual, consistent delivery speed to see the final 3 feet of the curve into the hole given the fall-line (see #4); retrace this final curve back out and follow it all the way to the ball; extend the tangent at the ball straight back to the fall-line for the target spot; use this fall-line target spot as a 2nd “hole” for a straight putt with right touch (same delivery speed to imaginary hole as used to read putt into real hole); commit to this imaginary line and distance for usual delivery into the 2nd “hole.”

2. Aim straight at target “hole” on fall-line.

Stand behind the ball and use the shaft as a visual ruler to “connect the dots” of ball and target; see the aim spot along the shaft edge in front of ball 5-6 inches; walk to the ball and aim the putter face thru the center of the ball at this aiming

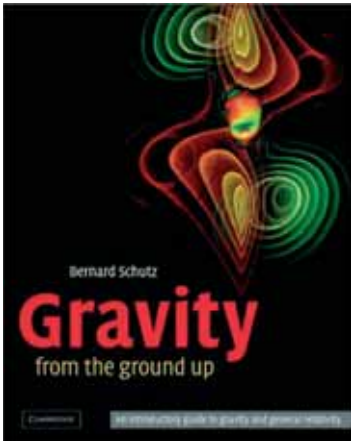
spot 5-6 inches in front; set up to the aimed putter face with good posture; align the neck / throat line parallel to the leading edge of putter face, automatically aligning the shoulder frame parallel to the target line (see #3); settle other joint pairs and stance in comfort and balance while keeping the shoulders aligned; "face" the ball and look where the face aims; turn or swivel the head like an apple on a stick to "face" down the line the putter face aims and learn where the putter face actually aims at the distance of the target spot.

3. Putt straight where the putter face aims.

Setup to the aimed putter by "walking" naturally-hanging hands and arms out to the poised and waiting putter handle without "reaching out" to the handle or changing the aim or flatness of the putter sole on the surface; set the throat line from center of chin to top of sternum to parallel the top edge of the aimed putter face; test the distance back from the ball, allowing the rear hand to swing free, as only a "sideways" swing is neutral whereas the hand's swinging in to the thigh or out to the nose is, respectively, too far back or too close; anchor the lead hip for the backstroke; perform a last "touch" look down the line at the target (see #4); use the lead shoulder to start the backstroke with a ballistic toss to "join in" the on-going internal sense of swinging back and thru, shoving putter sole back and up into the swing, while also keeping the "triangle" form (2-3 muscle tone on scale of 1-10) with dead hands / arms "riding" this swing; once the torso and shoulder frame resquare coming forward, hold the neck line still at the midline during the remainder of the thru-stroke; allow the putter momentum to define its own forward trajectory, with this momentum moving the lead shoulder vertically upwards from the balls of lead foot.

4. Putt with the usual tempo and touch.

Internalize the sense of green speed on the practice green using the “core putt” (2 balls putted same distance with same backstroke size and downstroke tempo to allow green to show how your stroke, putter, ball, and tempo work on today’s surface) to register and calibrate usual backstroke-force relations with your tempo; perceive any adjustment to the exact speed on each green on the course plus uphill / downhill effect(s); setup with the neck / throat and skull-eye line and “face” the ball with a straight-out gaze (see #2 & 4); rotate the face and head (like an “apple on a stick” of neck axis thru the top of the head) down the target line to the second “hole” as if watching a perfect putt with realtime motion, achieving the correct neck angle from ball to target, and teaching the body “here” and “there” for the instinctive stroke size; rotate the face back to the ball; allow balance / vision to settle; “jump in” the ongoing tempo swinging by starting the putter back instinctively; allow instincts to “size” the top of backstroke; stay with the usual downstroke timing.



Expressed even more prosaically, the golfer gains a familiarity with how the green speed reacts to his usual stroke, and then visualizes with tempo for accurate predictions of the break, uses the curvature of the final three feet of break to identify a target on the fall-line, aims the putter face straight at this target and sets up to the putter face as aimed, takes a last look to polish off the sense of distance, turns the brain

completely off and just makes the same old beautiful stroke as usual, with the usual tempo, and allows the instincts full reign to perform their vital function of sizing the backstroke.

Chapter 10: Drills for Putting Skills

PUTTINGZONE DRILLS



55 Drills for Putting Skills

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1. READ TO PICK THE TARGET

1. Find the fall-line thru the cup – test it by making a putt straight up the line you believe is the fall line – if the ball curves left, move your ball to the left and putt straight again – if the ball curves right, move your ball to the right and putt straight again – continue until the ball rolls straight uphill into the cup (this line is the actual fall line) – assess how well you did in identifying the fall line accurately to begin with.
2. Find the head of the Spider – from 10 feet on a flat-but-tilted surface, putt along the axis of tilt with drop-in speed directly at the hole and note how low the ball is when it reaches the fall line – stick a tee at this distance above the hole on the fall line for an aim spot or target – putt 10-footers at this tee from any location on a circle around the hole – see whether your assessment of the aim spot is accurate or too high or low.
3. Spiral drill to see the spider — place a ring of balls around a hole on sloped green starting at 2 or 3 feet and spiraling out one foot more each ball to ring the hole, then putt each ball into the hole in succession without missing any (start over if one is missed), and repeat the process setting the balls around in the opposite direction.
4. Downhill putts — lay a shaft alongside the fall line on the far side of the hole and practice touch so that the ball rolls just to the corner made by the top lip and shaft, feeding at the last down the central fall-line without impacting the shaft.
5. Box the break — find the apex (maximum height of breaking path off a direct line from ball to hole) and make a rectangle to “box” the surface involved in the putt with long side from inside ball to inside edge of cup on low side and with parallel high side crossing thru the apex – the ends of the box connect these two long sides, one end right behind the hole and the other end right behind the ball – stick a tee peg in the ground at the apex and put another tee in a continuation of the

line from ball to apex where this line reaches hole high as far as the far end of the box - line up directly at the apex and putt straight at the second tee target past the apex that is hole high – observe whether putting at the apex is too low for an aim spot – select a second spot along the high long side of the box that is nearer the ball than the apex and place a tee there and also place a second tee on this same line as far as the back of the box, so that by starting the putt at this first tee and putting to the second tee for distance, the ball will first head uphill and then turn parallel to the long sides right at the apex.

6. Putt over the rainbow – find the apex and place a line of three tees about 3-4 inches lower than the apex in a line parallel to the baseline (direct line from ball to hole) – putt so that the ball stays on the high side of these tees and is changing direction from uphill to downhill right thru this region.

7. Read the putt backwards out of the hole like running a real-time movie in reverse – identify the exact shape of the curvature of the break for at least 2-3 feet back from the entry point on the lip – using this shape, extend the curve all the way back towards the ball and note what segment of this path finally straightens out – use this straight part to aim the putter face for the start line and putt so that the ball starts off along the back or high side of the “hump” of the break.

8. Undulations / Tiers – work backwards from the hole to the beginning of the undulation or the edge of the surface feature, seeing the ball back out of the hole in real-time visualization – note the point where the path of the putt would “exit” the undulation feature – treat the undulation as a separate problem and find the “entry” point to negotiate or transit this feature on the opposite side or edge (closest to your ball) – send the putt into this feature at the entry point so that it leaves the feature at the exit point with the appropriate speed to finish up over the critical final pathway into the hole.

2. AIM AT THE CHOSEN TARGET

1. Pick a reference spot just in front of the ball on the target line from behind the ball - square the putter face using only the center of the ball and that spot - have someone hold the putter in its aim while the player goes back behind to see how well he did, using a visual ruler to line up the putter face with the target.
2. Use a business card for one golfer to watch the stroke path of another — standing behind the golfer facing down the target line and using the right hand, hold a business card's long edge vertical in front of the dominant eye's pupil so that the ball and the target connect along this edge of the card — then when the golfer makes the stroke, the person watches the relationship of the putter head to the edge of the card to see whether the putter head sweetspot stays along the edge of the card or travels inside or outside and if so, by how much.
3. Line up the logo or line on the ball at the target – back away and check the line to make sure it is aimed accurately – square the putter face to the line on the ball – do not look at the target and just putt straight – assess how well this works for you.
4. From behind the ball, use a visual ruler to select a spot 5-6 inches ahead of the ball and square the putter face thru the center of ball at this point to aim along a straight putt at a hole or target 4-5 feet away – setup to this aim of the putter and make a straight stroke and judge how accurate the aim was.
5. Tune in the aim by deliberately mis-aiming the face to the outside of the target – then mis-aim to the inside of the target – then rotate the putter face from inside onto the target – go behind the putter as someone holds it to assess how well you have done.
6. Putt the Hole or Target – setup at the ball aimed at the target – walk to the target (or hole, as the case may be) and setup as

if putting the target itself (instead of the ball) further down the same line – note the offset of your feet standing at the target – move back towards the ball and stop halfway and aim again at the target – continue back to the ball and setup again and aim so that your ankles are aligned right at the position your ankles were in when standing beside the target.

7. Aim the putter face thru the center of the ball at the target and look perpendicularly out the front of the putter face and out the equator of the ball that is nearest the target to a point on the ground about 4-5 inches in front of the ball – set the face behind this forward point as if to putt the point itself, so the face is still aimed at the target – reposition the face behind the ball aimed at the target – putt so that the sweetspot of the face is moved squarely over this forward point still square and slightly rising.

3. PUTT STRAIGHT AT THE TARGET

1. Popup Gate — Stick two tee pegs in the ground so the line across both is square to the hole or target - rest the ball in front of the two pegs so that the back of ball protrudes to the rear side of this two-tee gate — with the putter face positioned squarely behind the two-tee gate, make a short lifting stroke with the neck staying back while the lead shoulder rocks vertically up from the ground to deliver the putter face flush into the two pegs at same time - this action sends the ball very straight and teaches that no matter HOW fast the ball is struck tempo-wise or with authority, the face still has to be square at impact and this is best done with a lift into the back of ball - this drill is a great confidence builder for short putts in the 3 to 6 range by demonstrating what works and why for rolling putts straight (Don Pooley and David Leadbetter tip).

2. Putt blind — aim the putter face in the usual way — once the golfer is happy, close the eyes and make a straight stroke — many golfers find this surprisingly accurate and finally focus on the feelings of the stroke at the time of pulling the trigger,

instead of watching the putter head in motion — this is the same as “killing vision” in favor of feeling the body’s stroke and is very similar to what Loren Roberts does mentally when he makes a stroke (his body action overrides his visual attention).

3. Windmill putt — a variant two-person drill is to have a friend stand astride the putt line three feet in front of you once you announce you are happy with the face aim — the friend blocks the vision of the target so the golfer can only stick with the stroke and the view at his feet — the golfer putts thru the friend’s legs like a windmill at a Putt-Putt without being able to see the target— this allows the golfer to “forget” the target once the putter face is aimed, and realize that the job is to putt straight only with reference to the putter face, not to try to continue targeting so he is putting at a target — the putter face aim “becomes” all there is to know about where the target is except for touch, and since that is instinctive anyway, there is no targeting of line or distance left to do — that way, looking down at the ball is exactly what the golfer wants to do, so there is no inclination to continue trying mentally to figure out where to hit the ball or to peek during the stroke.

4. Yardstick stroke —lay a yardstick or flagstick or club shaft down on the green and hold the putter a little lower down the grip so the bottom of the putter is just above the yardstick but the arms hang as usual — make strokes along the top of the stick so that for at least 6-10 inches on either side of the bottom of the stroke, the putter sweetspot stays above the stick and the face stays square to the direction of the stick.

5. Finger putting – hang the arms as in a setup and curl the fingers of both hands palm up to point at each other, in a posture similar to giving someone’s foot a boost but without the fingers intertwined — make a shoulder rock that keeps the hands and fingers aimed at each other during the stroke the same way they start out, without one hand swinging inside off

the other going back or thru — keep the upper sternum's line coincident with the gap between the fingers during the rocking motion.

6. Butt Putt — stick a tee in the butt of the putter – setup so the tee aims into your sternum — make a shoulder rock that keeps the tee aimed at the sternum.

7. Drop and Stop — make a backstroke and let the putter drop down along the same path used for the backstroke, but right when the putter head reaches the middle of the body and the bottom of the stroke, stop the putter head abruptly — assess whether your shoulders and hands are still aligned square to the target and whether the face is aimed square.

8. String Line— use steak skewers or shish kabob sticks or tent stakes or long nails etc. and string to make an elevated string line above your putt line 8-10 inches above the ground — use the string to practice squaring up, setting the throat-line and skull line to the target line, running the line of sight straight sideways down the target line, and making strokes that roll balls straight beneath the string.

9. Pointer Putts — have a friend aim your putts by holding a shaft directly above your ball pointed at the target — make strokes beneath the shaft.

10. Flagstick Shadow – in the morning or late afternoon, find a reasonably level green with a flagstick shadow and use the shadow line like a chalk line, watching to see that the ball rolls on the shadow.

11. Sole Train — setup at a ball and place a 2nd ball straight behind the sole of the putter just under 1 foot back and place a 3rd ball another foot back on the same line — make a backstroke that hits the 2nd ball with the back of the putter head and rolls / knocks it straight back into the 3rd ball — set all this

up so the 3rd ball is aimed at a hole 1-2 feet further back and putt the 3rd ball into the hole with your backstroke.

12. Tee it Up — find a straight uphill 10-foot putt and, where the ball sits, push a tee into the green until its top edge is just below the tips of the grass — tee the ball up and putt straight over and over — in the process, place a second tee all the way down into the green about 6 inches behind the putter head at address directly on the putt line and make sure the takeaway is sending the sweetspot over this point and never outside it.

13. Chute Putt — setup a straight putt — 2-3 feet out from the ball, place two tee pegs in the ground to form a chute across the putt line, with one peg about 2 inches outside the line and the other about 2 inches inside the line — putt the ball straight thru the chute to the hole — later narrow the width of the chute.

14. 8-Ball in the Corner — set a second ball on the lip for a breaking putt right where the putted ball should enter the cup — putt a ball so it bumps this second ball at the lip gently into the hole, leaving the putted ball on the lip.

15. Palace Guard — set two balls at the lip a little wider apart than one ball's width — putt so that your ball enters the cup without disturbing either ball — also use this on breaking putts by arranging the two-ball gate to define the entry path.

16. Putt the Sleeve Box — lay a sleeve box on the green with the long direction aimed at a target — putt the back of the box with square impact by the putter face so that the box slides straight away towards the target and does not twist.

17. Doublemint Putt — putt two balls at once – aim the putter face against the back of two balls slightly separated from each other — make a stroke that impacts both balls at exactly the

same time with the faced moving square thru the gap between the balls.

18. Putt the quarter — stick a quarter in the green edgewise until it stands up straight on its own — putt the quarter straight away, as only square impact with a slight rising will send it rolling on plane for any appreciable distance — see how far you can putt a quarter.

19. Reach out and Putt Someone — move the ball forward of the middle of your stance at least 3-4 inches — make a stroke that bottoms out in the middle of your stance and still contacts the ball with the sweetspot moving square and down the line, even if naturally rising a little.

20. Back of Lead Hand at the Butt – have a friend stand down the target line from you and poise the butt of a club about 2 feet in front of the hands aimed at the back of the lead hand's wrist — the club shaft will be parallel to the putt line — make a stroke that sends the back of the lead hand straight against the butt of the club.

21. Baseboard strokes — setup with the toe of the putter about a quarter or half an inch away from a baseboard of a wall or from a 2x4 on the green — make strokes that result in the toe of the putter not moving any closer to the wall or board.

22. Door frame strokes — setup so the putter head is on the line on the floor between the two sides of a door frame — make a backstroke that sends the putter sweetspot against one side of the door frame and then a thru-stroke that sends the putter sweetspot against the other side of the door frame, meeting the vertical surface of the door frame board with the putter face flush to the board.

23. Compare an in-plane shoulder action with a screen-door shoulder action so the golfer learns the difference in terms of

feel — set a 2x4 board on the green along a target line and run the heel of the putter along the far vertical side of the board with the putter face staying square to the vertical surface of the board for an in-plane stroke — now set the toe of the putter near the inside vertical surface of the board and use a “putting arc” path for the stroke action in which the stroke curls inside in the backstroke and inside off the board in the thru-stroke in a symmetrical pattern — then set the toe of the putter near the inside vertical surface of the board again and this time use a “putting arc” path for the stroke action in which the stroke curls inside in the backstroke but conforms to the line of the board coming forward and from the middle of the stroke going thru to the follow-thru — pay attention to the different body actions of the neck, shoulders, arms, and hands involved with the different sorts of motions.

24. Battering ram action — hold the putter horizontally in the setup with the butt pointing along the line of the balls of the feet — make a battering ram motion with a shoulder rock that keeps the shaft straight and in a vertical plane (no curling back or thru) and delivers the butt straight away .

25. String Line Stroke Squaring — with the putter face aim matching the string line, make strokes with the intention of delivering the thru-stroke to the string so that the sweetspot of the putter head touches the string and the putter face is square to the string — notice how keeping the throat-line square back at the mid-line of the stroke while allowing the lead shoulder to rock up vertically from the balls of the lead foot is the stroke dynamic that makes this happen.

26. Drop the putter head — at either the top of the backstroke or the top of the follow-thru, allow the putter head to drop straight down to the surface to see whether the sweetspot lands on the target line or to the inside of the line.

4. PUTT WITH INSTINCTIVE TOUCH

1. Core putt – using the same backstroke length where to go further back feels like you have to lift the putter (just past the rear foot in a comfortable stance), and using the same tempo, putt two or more balls EXACTLY the same distance — observe how far along level surface the green allows this stroke to roll the balls — this reference distance for the core putt calibrates the golfer to the green speed, so that longer and shorter distances build around this core backstroke, making the instincts more sharply tuned to that green speed.
2. Putt to a tee peg — set a tee peg upside down on the green or indoors carpet like an obelisk and putt a ball to the peg from an appreciable distance so that the ball touches and jostles the peg without knocking it over — repeat from various distances.
3. Putt in the 6-12 foot range and try to have the ball stop right at the lip without going in the hole — draw an “porch” area in front of the lip of a cup that extends out towards the ball about 6 inches — from about ten feet away, try to stop as many balls out of ten within 6 inches of the lip on this “porch” on a path that would actually go in if a little longer (and not headed outside the hole) — credit your putt only if it makes it as far as the porch, otherwise do not count that stroke in the ten tries — note how many putts cannot be stopped and actually roll into the hole, indicating that an instinctive stroke usually has a little extra built into it for distance.
4. Stick a tee peg in the green loosely next to the lip where you expect the ball to go in the hole and putt so that the ball tumbles the tee peg into the hole — this teaches that thinking about a specific task in a playful “game” fashion is more specific than the usual “sink the putt” attitude and focuses targeting and produces more precise control and results.

5. Rabbit and Dog — putt one ball — putt the second ball exactly the same distance to just bump the first.

6. Stack 'em — putt a ball to a far fringe — putt a second ball as close as possible without going farther — continue stacking balls back along this line until you fill the distance from you out to the last ball in the stack — if a ball goes farther than a previous ball, count your stack and start over.

7. Halving Lag drill — setup to a long (35-55 foot) putt — putt the first ball halfway — putt the second ball 3/4th the way — putt the third ball all the way — start over but for the first and second balls substitute a practice stroke — practice stroke 1/2 way, then practice stroke 3/4th way, then putt a ball all the way to the hole.

8. Finishing Up Lag drill — focus only on the last 5-10 feet of a 40-foot breaking putt — putt three balls and leave the first ball about 10 feet short, the second ball about 5 feet short, and the third ball at the hole and not long — practice visualizing the ending roll of the ball over the last ten feet so the movie is vivid and let that guide the stroke for touch.

9. Fall-line Lag drill — pick a target in the background scenery beyond the far fringe of the green and then place a tee or ball along that start line at the fall-line thru the cup — then putt all the way to, but not past, that hole-high target.

10. Elephant's Ear Lag drill — setup to a long breaking putt — at the hole, note the direction the ball should enter the cup and extend a line straight away from the center of the cup out thru this high-side entry point for about 2 feet from the lip — treat this line as the diameter of a circle and either draw your finger thru the grass to mark it or lay a segment of string down in a circle to mark it — back at the ball, aim sufficiently high and putt with enough slowness / softness that the ball climbs the hill, breaks downhill, and ends up just trickling

into this circle and stopping short of the hole (the circle is the elephant's ear).

11. 4 Corners — to learn a green and master it, putt 2 balls from the low fringe to the high fringe, cross over and repeat in the opposite direction — then putt from fringe to fringe sideways across the green 2 balls in each direction — setup to any “long” putt on this green and realize you can easily master the distance since you have already putted the worst the green has to offer.

12. Fringe Hopping — putt a ball along the fringe without leaving the fringe — make the identical stroke on the green, and compare the two lengths that result, effectively comparing the green speed of the green with that of the fringe — note that the fringe is about half as fast as the green — setup a ball in the fringe — putt straight off the fringe across level green at a hole as if putting completely on the green (the ball will stop short) — pick a target on the far side of the hole that is the same distance past the hole that the ball is off the edge of the green — putt at this farther target as if putting completely on the green — if the fringe is twice as slow, then this extra target length makes you putt twice as much fringe distance and so allows you to putt for distance as if putting completely on the green.

13. Uphill / Downhill Touch — estimate the Stimp of the green (e.g., 9) — estimate the Slope percent of the green (e.g., 3% or 3' of rise for every 100' of run, 3" rise for 100" run, etc.) — multiply the two numbers (e.g., $9 \times 3\% = 27\%$) — add or subtract this percent from your putt's actual length and treat the putt as a longer or shorter putt by this much AS IF level (e.g., treat a 10-foot uphill putt as if it were level and 27% longer, or 2.7' longer — that is, treat it like a 12.7-foot level putt).

14. Ram 'em Jam 'em — setup about 3-4 feet away from a hole on a straight putt — stroke putts until they are going too fast to drop and pop off the back center of the cup — reduce the speed until the balls are just dropping and sink as many as you can — then reduce to about half that speed and continue — and finally reduce to a speed that just gets the ball to the hole with a little extra (about 1-2 revolutions per second at the lip).



Fredrik Jacobson, delivering the putter face squarely down the line with his no-hands shoulder stroke that rolls the head and face thru impact with the shoulder rock.

Appendix A: Bibliography of Putting

Bibliography of Putting Instruction 1830-2007

For sources to purchase any of these books online, especially the Out-of-print titles, visit the PuttingZone.com Bookshop at <http://www.puttingzone.com/shopping.html>.

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PGA. PGA 2000 Teaching Summit Series (VHS).

PGA. PGA Teaching Summit Pre-2000 Videos (available as a Putting Set) (VHS):

48: Paul Runyan, Chipping and Putting (VHS).

46: David Leadbetter, Chipping and Putting (VHS).

68: Jack Lumpkin & J. Redman, Chipping & Putting (VHS).

69: Dave Pelz and Carl Welty, Putting (VHS).

106: Jerry Mowlds, Putting Drills (VHS).

E4: Harold Swash, The Basic of Putting Perfection (VHS).

PGA Tour Golf. Short Game (VHS).

PGA Tour Golf. Tips from the Tour (VHS).

Phillips, Dave. Putting: The Short Ones (Golf Magazine Top 100 Teachers: More Up & Downs, 2005) (DVD).

Progress Research Org. Intermediate Putting (VHS).

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Rosa, Nicholas. Integrating Mind & Body: NLP for Better Golf: Putting (Peak Performance Psychology for Golfers 1998) (audio cassette).

Rosburg, Bob. Total Putting Guide (VHS).

Rotella, Bob. Putting Out of Your Mind (1996) (audiotape).

Runyan, Paul. Short Way to Lower Scoring, 2 vols. (VHS).

Runyan, Paul. Chipping and Putting (PGA Teaching Summit 48) (VHS).

Saunders, Vivien. Putting (VHS).

- Schaubel, Charlie. Chipping & Putting (VHS).
- Selders, Todd & Gleason, Ted. Competitive Drills and Games for Golf Practice (VHS).
- Simmons, Pat. Putting: The Science and the Stroke (Tiger Shark Play Better Golf) (VHS).
- Skelley, Bill. The Short Game (VHS).
- Smale, Tim. Become a Deadly Putter (GolfHypnotherapy.com) (CD).
- Small, Laird. Putting: Great Strokes (Golf Magazine Top 100 Teachers: More Up & Downs (2005)) (DVD).
- Sones, Todd. Putting: Pendulum and Path (Golf Magazine Top 100 Teachers: More Up & Downs, 2005) (DVD).
- Sport America, The Putting Game (VHS).
- Stockton, Jr., Dave. Golf Clinic (1994) (VHS).
- Stockton, Jr., Dave. Inside the Scoring Zone (PGA Partners Club Game Improvement DVD Series) (DVD).
- Stockton, Jr., Dave. Precision Putting (1986) (VHS).
- Stockton, Jr., Dave. Putt to Win (2002) (DVD).
- Stockton, Jr., Dave & Crenshaw, Ben. Insights From The Masters of Putting (2003) (DVD).
- Swash, Harold. Best Kept Secret in Golf (VHS).
- Swash, Harold. Lower Your Golf Score — Putting Insights by Harold Swash, Europe's Putting Doctor (VHS).
- Swash, Harold. Perfect Putting (VHS).
- Swash, Harold. Putting: Fundamentals (PocketShot Videos for iPod and mobile phones) (MP4 downloads).
- Swash, Harold. Putting: The Complete Guide (DVD).
- Swash, Harold. The Art of Championship Putting (VHS).
- Swash, Harold. The Basic of Putting Perfection (PGA E4) (VHS).
- Thuny, Andy. Putting Tips (DVD).
- Toski, Bob & Ness, Tom. Putting for Profit, Golf Dig. vol 6 (VHS).
- Trevillion, Paul. Missing Impossible (VHS).
- Trevino, Lee. Chipping and Putting (VHS).
- Trevino, Lee. Putt for Dough and How to Read Greens (VHS).

Trittler, Paul. Putting: Green Reading (Golf Magazine Top 100 Teachers: More Up & Downs, 2005) (DVD).

White, Donna. Beginning Golf for Women, the Short Game (1998) (DVD).

Winters, Robert. Putting Genius (Subconscious Training Corp., Golf-Mind Software Vol. 2 2002) (audio CD).

Wiren, Gary. Greater Golfer in You: A Total Approach (VHS).

World Series of Golf. Putting Guide (VHS).

Putting Instruction eBooks

Bryan, Tony, Golf: The Short Game, <http://www.tony-bryan-theaudioebookguy.com/>.

Cotter, Robert, "Putting Rebel — Conversation with a Putting Wizard", <http://www.instantgolffesson.com/>.

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Higham, Karl, Cut 3-5 Strokes in 10 Minutes, http://e-library.net/Cut-3-5-Strokes-in-10-Minutes__visit5633.html.

Mandigo, Matt, Putt Like a God, <http://www.amazing-putting-tips.com/>.

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Myers, Scott, Breakthrough Putting Secrets Revealed, <http://www.puttingsecretsrevealed.com/?hop=gtrainer>.

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Appendix B: PuttingZone Academies & Coaches: PuttingZone™ Academies



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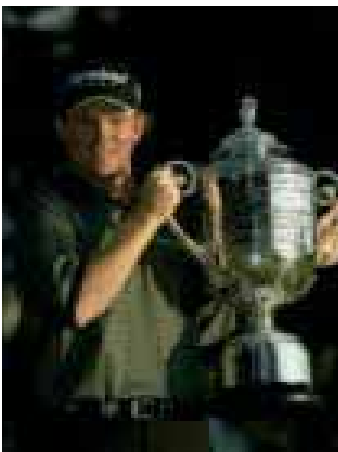
Adendorf Golf Resort, near Luneburg Germany
German National Headquarters, PuttingZone

Appendix C: About Geoff Mangum

Geoff Mangum is widely regarded as the most knowledgeable putting instructor in the game. He has studied putting more extensively and deeper than anyone in history for nearly twenty years. Mangum's teaching combines the best of existing golf lore with what he has learned about vision, the body, the brain, and instincts in putting. The result is "The Mechanics of Instinct" — a total approach to reading putts, aiming the putter, making a straight stroke, and controlling the distance that veteran teachers describe as the best in the history of golf. He is recognized throughout golf as the top expert for vision in putting as well as for brain-body processes in putting.



Mangum's first PGA Tour student after a single lesson improved from 160th out of 185 players on Tour in putting stats to winning a major with his putter in less than two months for his first-ever victory. Shaun Micheel won the 2003 PGA Championship at Oak Hill, and later said: "Everyone remembers my seven iron (to inches on the final green), but my putter won me the PGA."



Micheel was 16th in the field that week with his putter. His Tour earnings nearly tripled. Micheel also finished runner-up to Tiger Woods at the 2006 PGA in Medinah, and a month later defeated Woods in match-play in England, using deadly putting on both occasions.



Ben & Florentyna Parker at the Jr Orange Bowl Invitational 2005

Mangum has similar successes at all levels of golf. Ben Parker, the teenage son of golf teacher Tim Parker from England, worked for three years with Hank Haney and grew to be one of Europe's top junior players. Right after just two lessons on putting with Mangum, Parker set the world on fire. He

opened the 2005 Junior Orange Bowl Invitational with rounds of 63 and 67 and strolled to victory against the best juniors in the world. The next month, Parker played against adult amateurs in the Tasmanian Open, and started off with a stellar career-best 62 before winning the event and earning an invitation to the Australian Open.

Other successes include:



Blake Adams

@ a mini-tour player (Blake Adams) who listened to Mangum on a hilltop green in the dark and the rain at night, in the thunder and lightning, and awoke the next morning to fire a career-best, course-record, tour-record 62, and win his tournament going away;

@ a young amateur (Travis Lethco) with a stroke average of about 75 who took 2 lessons and then fired a personal-best, course-record 63 and then in his Freshman year as a collegiate golfer finished 8th in the nation in the NCAA Finals;

@ a 23-year-old female golfer (Katja Dammann) who has been golfing only four years and who worked with Mangum over the course of a year and then won five tournaments in the Amateur World Tour against guys and Fall 2006 won the A Flight

in the Tour Championship at Hilton Head Island with a raw score that was better than all except 10 of the Championship Flight golfers, outplaying 450 guys and being named Woman Golfer of the Year in NC;

@ a 45-year-old casual golfer (Mike Crawford) with a 10-handicap who took two lessons, reached scratch within two months, and won his club championship by defeating a recently graduated Wake Forest collegiate golfer who was the reigning club champ three years running; and



Katja Dammann

@ an English rookie pro on the European mini-tour (Chris Hanson) who fired a 64 right after a single lesson and went on that year to finished as a Champion and third on the money list for his Tour.



Chris Hanson working with coach John Eyre and Geoff Mangum

Mangum has taught a number of the top teachers in golf, as well. In 2005, he was the featured putting speaker for the European PGA Teaching and Coaching Summit in Munich, attended by over 1,000 PGA members from 35 countries. Teachers praising his presentation included Hank Haney, Ralph Mann, Scott Cranfield, Beverly Lewis, Stefan Quirnbach, Reiner Mund, Scott Cranfield, and Fanny Sunnesson.

He has taught Jim McLean, the staff at the David Leadbetter Junior Golf Academy, GM Top 100 Teacher Ted Sheftic, and a host of other prominent teachers. Mangum has taught 100s of PGA teachers in the US, Ireland, England, Germany, Switzerland, the Netherlands, Sweden, Denmark and Norway, including Annika Sorenstam's coach Henri Reis, his current top student Christian Nilsson, and Ryder Cup star Henrik Stenson. His courses earn credit in the UK, Germany, Sweden and Norway, and he has been featured in the PGA Professional, the official magazine of the UK PGA.



Ted Sheftic
Golf Magazine Top 100 Teacher

Mangum conducts clinics worldwide and holds personal sessions and certification and academy training programs at a number of North Carolina facilities, including:



European PGA Teaching Summit

Tot Hill Farm GC, Asheboro NC
Woodlake CC, Pinehurst NC
Hylands Hills GC, Southern Pines NC
Whispering Pines CC, Whispering Pines NC
The Challenge, Graham NC
Bryan Park GC, Greensboro NC
Meadowlands GC, Winston-Salem, NC
Salem Glen GC, Winston-Salem, NC
Rock Barn Golf & Spa, Hickory NC
Hampton Heights GC, Hickory NC
Renaissance GC, Charlotte NC ¶

Appendix D: PuttingZone Opportunities

Join the PuttingZone. Learn and grow in golf in the following ways:

MEDIA / WEBSITES:

Websites: join over 100,000 golfers from around the world in visiting the PuttingZone website (<http://puttingzone.com>) for information and pleasure and participate in the Flatstick Forum (<http://www.network54.com/Forum/52812>), where tens of thousands of golfers from over 50 countries exchange views on putting;

Newsletter: sign up for the PuttingZone Newsletter (<http://puttingzone.com/newsletter.html>);

Magazine: subscribe to or advertise in the forthcoming PuttingZone Magazine, golf's "first and only" magazine devoted to putting (<http://puttingzone.com/PR/pr015.html>);

Podcasts & YouTube Videos: subscribe to the PuttingZone Podcasts (<http://www.puttingzone.blogspot.com>) and YouTube Instructional Video collection (<http://youtube.com/user/geoffmangum>) and receive new podcasts and videos in your email;

Syndication: carry short PuttingZone putting tips and stories in your newspaper on a syndicated basis;

Links Exchange: exchange website links and grow traffic synergistically, including posting the PZ dynamic content widgets for the latest Podcasts and Videos on the PZ Channel (<http://puttingzone.com/linkinfo.html>);

COACHING SERVICES:

Lessons / Clinics: come to North Carolina for a lesson or join in on one of the worldwide clinics throughout the year as calendared on the PuttingZoneClinics.com website (<http://www.puttingzoneclinics.com>);

Coaching: schedule a 1-on-1 lesson or a slate of lessons to take your entire golf game into the caliber of play you've always wanted to experience on a regular basis with Geoff as your "Personal Putting Coach";

Pro "Play for Pay" Partnerships: Tour playing pros enter into one of the unique but simple "Play for Pay" Partnerships (http://www.puttingzoneclinics.com/videos/tour_pros.swf) with Geoff as your putting coach — get past relying upon caddies and swing teachers for putting — it's wasting your too-brief career! (contact Geoff for details at geoff#@puttingzone.com or 336-340-9079);

School Staff Seminars: have Geoff spend a day with the staff at your golf school to explain how modern brain science contributes to optimal putting techniques in ways that the staff is guaranteed never to have heard before from any other source — innovation for the 21st century that your school needs to complement the "full swing" expertise with top putting expertise; learn what and how to teach with a complete turn-key putting program.

City Tour Clinics: attend or host a City Tour Clinic (<http://www.puttingzoneclinics.com/content/view/17/31/>) at your golf course and share the revenue;

ProAms with Clinic: sponsor a ProAm Clinic combined with a PuttingZone Clinic for participants and share the revenue (<http://www.puttingzoneclinics.com/content/view/18/32/>);

Travel Clinics: go with your pals to an exotic or historical or fabulous golf location around the world in a Tour arranged by Geoff, and let Geoff accompany you for the whole time as guide and putting coach, combining group sessions and 1-on-1 focused work in a beautiful, fun setting;

Business Golf Corporate Services: invite Geoff and his associates Hilary Bruggen-Fordwich of Strelmark.com and Ed Feeney of Ed Feeney Associates to conduct a business golf seminar for your leadership team in a Golf Resort setting and provide invaluable tools for “getting and keeping clients” with golf as the best tool for “Customer Relationships Marketing” (<http://puttingzone.com/corporate.html>); the best CRM golf seminar in the business.

PARTNERING UP / B2B:

Coaches / Academies: become a certified PZ Coach (<http://puttingzone.com/certification.html>) or Academy owner (<http://puttingzone.com/franchises.html>) and join the best putting instructors in golf as they work hard at solving problems of teaching and learning;

Website Ads: advertise on the PuttingZone websites — PuttingZone.com, PuttingZoneClinics.com, PuttingZone Blog — and reach over 100,000 golfers monthly on the top-rated website in golf for half the game — number 1 in Google for six years running (contact geoff@puttingzone.com or 336-340-9079 cell for details);

Magazine Ads: advertise in golf’s first and only magazine devoted to putting — nearly half the game in one exclusive, “must-read” publication — at rates about 25 TIMES lower than the giant consumer publications,

designed to support and nurture innovation in golf by the independent contributors (contact Geoff about premier issue and publishing calendar at 336-340-9079 or geoff@puttingzone.com);

Writing: write for the PuttingZone website or Magazine — tips, articles on putting or products, reviews of putters and training aids, profiles of key people and players, marvelous venues and greenkeeping, and more;

Clinic Sponsorship: sponsor clinics by Geoff with signage and product presence and demonstrations;

Affiliate Links: make the PuttingZone website traffic work for your company with an affiliate link to your products and services;

Product Sales: offer your products directly from the PuttingZone's ProShop and help support the PZ on a commission basis that is better for you than anywhere else, because the PZ supports innovation in golf;

PZ Discounts: promote your products and services with special discounts exclusively for PuttingZone visitors — a win-win deal for you and for the PuttingZone as a community;

Consulting: contact Geoff about your training aid idea or putter design before the life savings are burned up in lawyers fees and prototypes, to avoid common mistakes and to take advantage of Geoff's 20-year study of what's already been tried and what might be added for little additional cost (http://www.puttingzoneclinics.com/videos/services_consulting.swf);

Science Studies: contact Geoff to review and advise about your science investigations and studies of putting

and putting technology to learn the overall perspective of designing for the skills of putting in a marketing environment or to engage Geoff for efficacy or other studies;

SPEAKING:

Live Interviews: call Geoff and schedule a live interview on your radio or podcast service for lively and thought-provoking ideas about golf and putting — he does these interviews regularly with great response! (<http://puttingzone.com/speaking.html>);

Group Lectures: invite Geoff to lecture your organization's teaching session — PGA sections, PGM programs, national PGA teaching summits, Clubmakers, Trade Associations — even the "Niners" coffee group at the Club! (<http://puttingzone.com/speaking.html>);

Corporate Speaking: let Geoff entertain and inform your staff while teaching about the efficient use of brain processes for focus and attention and efficiency on a daily basis, creative problem solving and error avoidance; people skills; and more — bringing you the most recent advances in brain research for immediate real-world application;

Trade Show Appearances: attract the crowd to your exhibit with special appearances by Geoff to showcase your products or services — entertaining, lively, important!

SPECIAL OFFERS:

2-CD PuttingZone Collection: You might also like to order Geoff's 2-volume CD-ROM PuttingZone Collection (<http://www.puttingzone.com/Info/cdorder.html>)

crammed to the gills with the best putting instruction in history, including:

- 43 short videos teaching the Four Fundamental Skills of Putting;
- the complete PZ Research Database of annotated references on putting art and science since 1830 along with the software and instructions for using the database, along with a Word version for even easier use;
- all of Geoff's written articles in Word .doc and .pdf formats as well as all of his audio Podcasts to date;
- hundreds of images for teaching and learning, including images concerning the gaze, the setup, grip form, golf history; and
- a high-resolution .pdf version of HA Templeton's Vector Putting — The Art and Science of Reading Greens, the ONLY book of any substance ever written for reading putts.
- over 1.3 Gigabytes of the best putting instruction materials in golf history. Only \$20 + \$4.95 S&H. / Europe: Euro 15.95 + 2.50 S&H. Mention "Hannibal the Cat" when ordering and receive S&H FREE.

The PuttingZone Book: Order additional copies of this PuttingZone book, Optimal Putting, for friends, staff, and students, and receive discounts for your repeat business, starting at 10% off with incremental increases in the discount for multiple-copy orders (mention "Hannibal the Cat" when ordering or inquiring).

Thanks for your interest and support!

Email geoff@puttingzone.com or call mobil +1 336-340-9079.

Let's get busy while the sun's still shining!

Appendix E: Friends of the PuttingZone

Want to Putt like the Pro's? - Then Practice like the Pro's!!!

As seen on TV!

From Scotland - The Home of Golf

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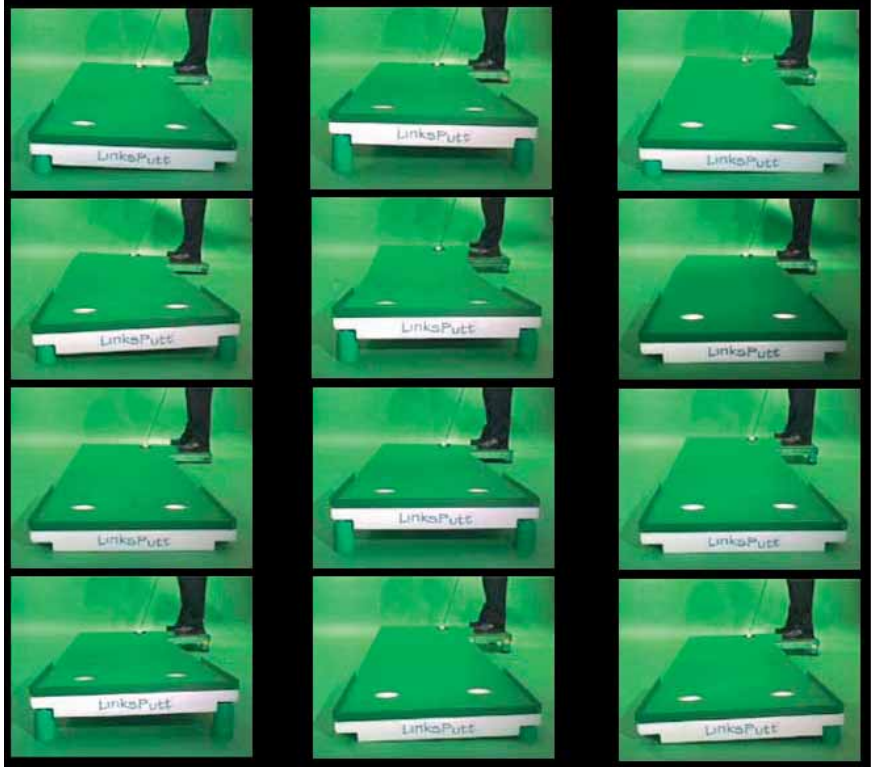
LinksPutt 4M

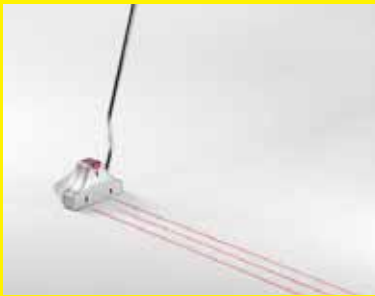
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Colophon

This first edition of Geoff Mangum's Optimal Putting is printed by Axess Printing of Cumming, Georgia, in a limited edition of 1,000 signed and numbered copies.

The design is by Geoff Mangum using the Apple iBook running the 1.33 GHz PowerPC G4 processor under Mac OS X 10.4.10. Design software includes Adobe InDesign CS, Adobe Photoshop CS, and Macromedia FreeHand 8.0.1.

The typeface is Optima for the body text and Stone Serif for cover, titling and references. Sumner Stone and Bob Ishi of Adobe created the Stone family fonts in 1987. Optima is a humanist sans-serif typeface designed by Hermann Zapf in 1952 and released in 1958 by the D. Stempel AG typefoundry in Frankfurt. The letters are based on the Golden Section and developed after studies and sketches done in Italy in 1950. Optima has deep affinities with classical Roman capitals, considered by Zapf as the ideal letter forms.

The cover art is an 1880 chromolithograph of the Royal Bengal Tiger from J.J. Johnson's Household Book of Nature containing full and interesting descriptions of the Animal Kingdom based upon the Writings of the Eminent Naturalists Audobon, Wallace, Brehm, Wood and others, ed. Hugh Craig (New York, 1880) (Plate VII, Carnivora). The original artwork is printed in 8 colors on a sheet 7" X 10" in size.

"We are all cats on the green." Geoff Mangum

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Optimal Putting Website

For readers interested in further details beyond the text of *Optimal Putting* and in on-going research and developments, more information is available at the special section of the PuttingZone website supplementing this book.



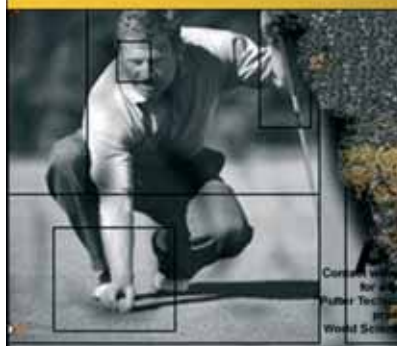
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