Technique is One Movement

[This article is a bit of history, written in 1981 for *Nordic Skiing* while I was a regional coach for the USST. I didn't know it at the time, but it reflects some aspects of modern systems-dynamic movement theory in its origins in Gestalt perception theory, which I had studied in graduate school for totally different reasons.]

Introduction

The following approach to cross-country ski technique has two main focal points: (1) a method of perceiving and therefore analyzing movement; (2) the basic elements of technique themselves. Without a consistent integrating method of analysis, the separate elements of technique will tend to appear and to be learned as separate movements and positions apart from the natural dynamic flow sequence which makes each movement functional in the first place.

In short, what I undertake here is a Gestalt-, or whole-form approach to technique. Two simple principles of Gestalt theory are basic to my analysis. The principle states: T<u>he whole is more than the sum of its parts</u>. We have all experienced how elusive as well as mysteriously potent that ultimate "click" situation is, how suddenly a skier "comes together" and begins to move with a perceptibly higher dimension of speed and efficiency. A Gestalt approach provides the means of directly perceiving that "together" whole-dimension rather than chipping away at it piecemeal.

The second principle states: <u>The whole determines the parts retroactively</u>. In other words, technique is not achieved through the simple addition of separate positions or movements. Each movement is determined in a necessary sequence in advance by the whole-phenomenon of body weight moving over the snow. Several comparisons is the following discussions will make clear the critical importance of maintaining a whole-focus, without which the constituent elements of technique may easily be misconstrued, if not mistaken altogether.

The Gestalt approach has a final advantage beyond maintaining a dynamic perspective on technique. It simplifies technique by drastically reducing the thought requirement to two or three points of sense perception, to a "feel" of joining body weight (center of gravity/mass) to speed and terrain without intellectual contortions or mental strain in either coach or athlete.

Technique is One Movement

Cross-country skiing is one movement comprised of a continuous rhythmical curve of forces. Speed and endurance are factors of simple natural momentum generated by muscle propulsion, elasticity, and body weight itself.

At the very outset there is a clear problem in finding a workable method of teaching and analysis. We may attempt to simplify the task by separating individual positions out of the continuum. Yet the subtlety, efficiency, in fact the true nature of each movement goes beyond the frame of any single static picture. The isolation of separate elements versus a whole-focus compares with the relation of a single frame picture to a movie sequence. In the former the critical dynamic element is left out.

Figure 1. shows an example of how using a static frame view misconstrues the nature of

dynamic movement. From a static frame side view it would appear that the point of weight contact with the snow is within the length of the lead ski in the new stride. Yet the speed factor places that point of contact with the snow in fact in front of the ski, demanding a much more dynamic up and forward attitude of the skier than he might expect from the static frame view.

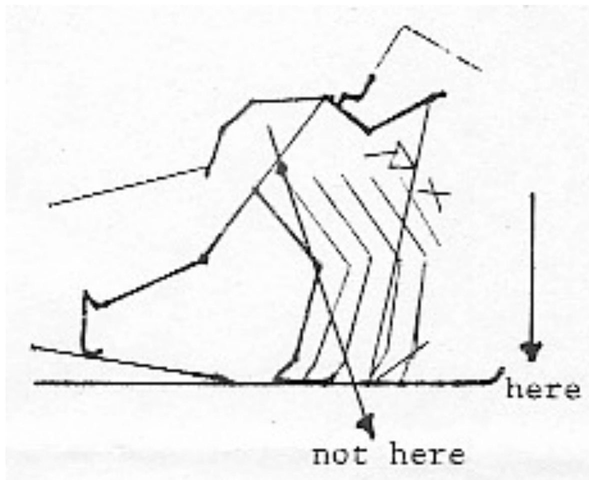


Fig. 1., from Dec. 1974, Davos.

An analogy might be drawn from music, in which any isolation of notes or groups of notes destroys the character and perception of the melody.

Thus the principle that the whole is more than the sum of the parts and the parts are determined retroactively, anticipated, by the whole. This holds true for moving through changing terrain on skis as much as for driving a car down a winding road. When a hill or curve comes, the driver does not use the "what do I do now?" approach; he responds to what the terrain "tells" him. Working from the whole situation back to the parts can also eliminate the question as to where good technique comes from, learning or just skiing a lot and fast. Skiing a lot and fast ultimately produces good technique in the top skiers because of natural accommodation of the body and perceptual apparatus to the whole-body weight-speed-terrain phenomenon. Yet it is a sad prospect if we all have to wait as long as it takes a good skier to become great for that accommodation to arrive. My feeling is that we can discover enough about the nature of going fast bby working from the whole backwards, even with young skiers, of any age, to make learning technique both more effective and vastly more simple.

Geometry vs. Ballistics

The film frame vs. film sequence comparison suggest a set of comparisons which can further clarify the true nature of technique. Drawing angles and analyzing body positions from a single frame view results in what I call the *geometric fallacy*. Some comparisons with the dynamic sequence view, or what I call the *ballistic approach*, will bring us to the concrete aspects of technique.

From the geometric point of view, forward movement is perceived as a vector of forces situation.

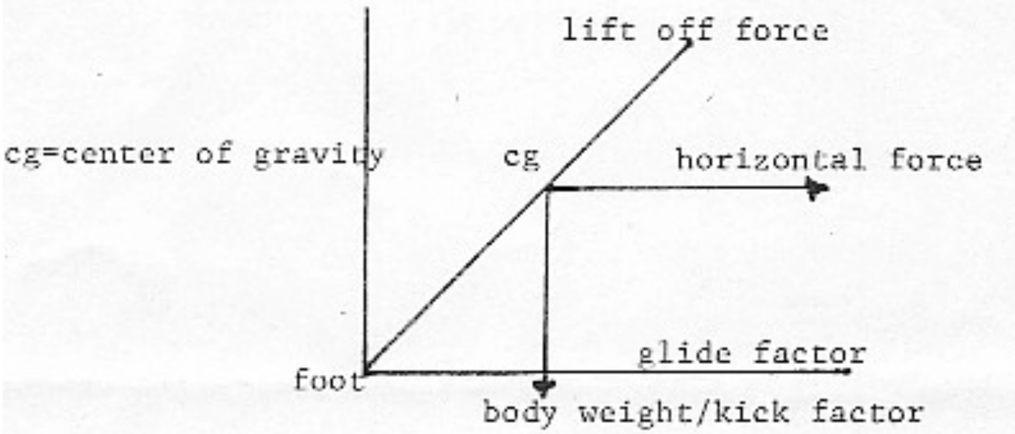


Figure 2. (Maier/Reiter, Skilanglauf Heute, p. 102)

The optimum lift-off angle is reckoned at 45 degrees, i.e. the best angle to both lift body weight and move it forward.

It terms of body physics and speed, this conception overlooks several critical points: (1) the point of contact with the track out front is not beneath the body or skis, i.e. close enough to drive or push it along, or balance over it by means of a simple linear angle lift. (2) The aim of such an angle lift it to move the center of gravity of the body along a horizontal line. Yet moving body weight along a horizontal line will cause a continual loss of elevation (or "carry") through the duration of the glide. Two negative results follow: the skier tends to stall out or slip behind his balance point over the ski, much in the manner of a ski jumper who is "behind it" or a football punt which does not tip over, or a frisby which goes up and slips back down. As a result the skier must compensate with muscle to constantly hold or re-elevate his center of gravity.

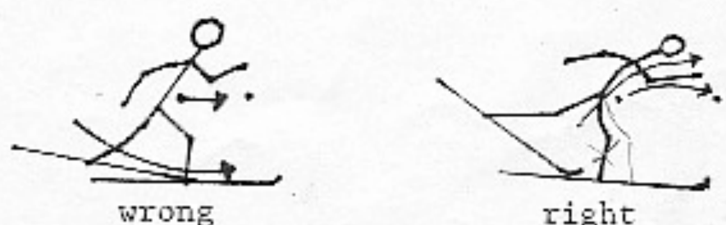


Figure 3.

The point of technique is to achieve horizontal momentum *without loss of center of gravity elevation or "float."* Otherwise over a longer stretch the skier may literally ski himself into the ground. The ballistic approach responds to this weight-movement phenomenon by recognizing that the shortest distance between two points is actually a *curve*, a necessary *trajectory* profile. The "up and over" attitude of the skier towards a point of contact well forward of his lead ski allows him to both maintain his elevation easily on bone support (riding higher, not on a bent knee driving down the track) and to effectively convert his static body weight into foot-pounds of momentum pulling over his balance point without further use of muscle power for stabilization or lift. One needs only to visualize the analogy with shooting, for example, to convert to the simply physics of the idea. Biomechanics has in fact determined that with the advent of fiberglass the angle of lift-off has changed from 45 degrees (1970) to 53 degrees (1974) (based on analysis of the top ten skiers in international competition. S. Maier/Reiter, p.104). This 53 degrees proves that the top skiers have reached a natural accomodation to increased track speed, I.e they are getting up and over in a curve profile rather than trying to achieve a straight line angle lift to a point and then riding a drive position. (I would disagree with Dillman's contention that the upper body remains stationary during the glide phase. USST Coaches' Manual, p.98. No part of the body remains stationary at any time.) Jakob Waser's cinegram of Thomas Magnusson displays the inverted curve profile for the center of gravity.

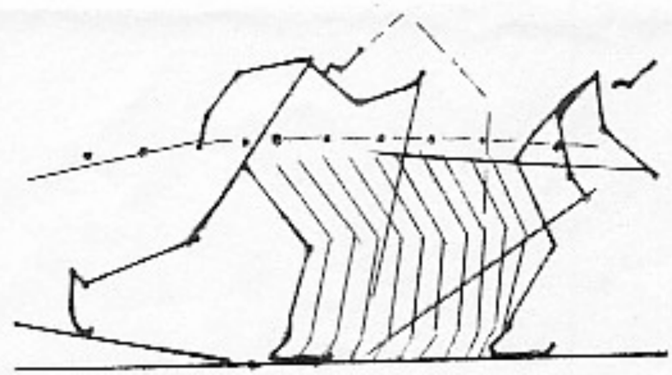
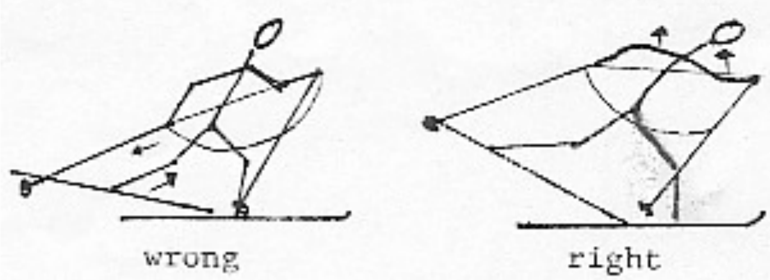


Figure 4.

Poling

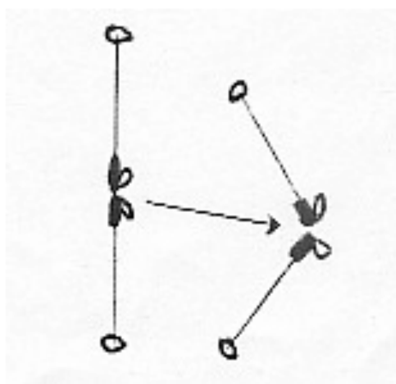
Applying the same geometry-versus-ballistics comparison to poling, similar conclusions can be drawn in favor of a trajectory curve rather than angle lines. Consider the pendulum line of the arm as a half-circle, the half line as the axis of poling. If the axis is conceived of as slanted forward and up, with the follow-through pointed roughly at the tail of the trailing ski, then two negative force patterns develop. (1) The point of the pole, just like the contact point of the lead ski, remains in front of the center of gravity, continually forcing the skier into the stall-out, re-lift situation. (2) The follow-through arm and pole are still pointing back and down when the lift-off leg is lifting forward and up. In other words, one part of the body is working *against* the other.



Keeping in mind the whole-situation (center of gravity ballistics), it is obvious that all parts of the body must lift up and over together. The axis of poling must be flat, parallel to the ground, the character of the follow-through not pointing back and down but rather a natural, elastic lift through the elbow and shoulder girdle. The pole tus compresses when the lift-off leg compresses, lifts as the total mass (elbow -shoulder) when the leg extends/lifts.

Leg Motion

Visualizing *lift-off and swing-through legs together*, the need for the ballistic attitude again becomes clear. If an attempt is made to add a separate power source by driving the swing-leg forward with a scooping motion to a bent knee, in order to move the center of gravity in a straight horizontal direction, much of the momentum potential of total body weight is lost. At best, one-leg power is being asked to carry static body weight forward; at worst, the knee gets forward of the center of gravity, causing it to stall out downward. A simple demonstration can be accomplished with two ski poles. Hold one on top of the other, handle to handle, and consider the bottom pole the driving hip/leg, the top pole the upper body. Move the center (handles) rapidly in a straight horizontal direction. The top flops back, the center begins to angle immediately downward as it moves forward. Scooping through with the knee invites this result, with its loss of upper body momentum and attendant low back pain from the hyperextension involved.



The ballistic attitude focuses on the total mass transfer of the body farther down the track. All related body movements lift up and over, rather than down and through underneath (Cf. Fig.3). In a literal sense, the skier must always be “on top of it.” The source of lift-off power should be broken down into what the different legs do simultaneously, one lifting, the other swinging through; concentration and momentum are diffused when the two legs are perceived as a unit moving in different directions. An early shift of focus from the lift-off leg to the swing leg also distributes the compression power of the body weight down then straight up off the lift-off leg. Whereas this latter compression-rebound movement (1) achieves as much as three times the body's weight in compression force, and early shift to a driving lead knee reduces that force to roughly half a body weight. When the skier is relaxed, focusing quietly in his senses on simple and single total movement, “on top of it,” the recovering leg will swing effortlessly to a precise point of contact with the track in front where the body will land in the next stride.

It has been established that the key to speed lies in increasing stride length, “distance per stroke.” (Dillman, USST Coaches' Manual, p.92) Yet it should be emphasized that increase in distance cannot be achieved by reaching or driving forward with the swing leg but only by a progressively more explosive lift-off. A simple experiment in maintaining center of gravity speed (what track people call trunk acceleration) can be repeated by anyone: running back along a beach, I tried to repeat the steps I had made in the wet sand while first running and still fresh. Since the experiment itself posed an artificial situation, I first attempted to land in my early tracks by means of reaching forward with the lead leg. No luck! I slowly lost ground until I fell completely out of phase with the early tracks. The instant I increased my lift-off force, became more naturally springy, my speed gained again, and my lead leg/foot began effortlessly dropping into the earlier tracks.(2.)

Pelvic Tilt

The up and over motion of a subtle, bounding stride generally describes and inverted curve, as I have said. But at the point of greatest extension the low back is either straight or even slightly hyperextended. How can the natural curve be continued? The answer is that no sooner is the point of hyperextension reached than the lower back and shoulders rebound or “break” back to a slight relaxed slouch, even while the glide is continuing and before any new lift-off takes place. This slump or soft “break” is critical to trajectory, continuation, and relaxation.

In physical medicine this “animal slouch,” “ teenage slump”(as I have described it to teens, who know it first hand), is called *pelvic tilt*. It is achieved by bending forward just a little at the waist, pulling the stomach in at the belly button, and pinching the buttocks together. Then relax totally, “go soft,” so there is no tension anywhere. Gently rounded shoulders are the result, and a feeling of great stability. This is the position weight lifters must learn, the posture mothers instinctively adopt lifting babies, tennis players about to hit a forehand. In short, it is the fundamental animal stance, central to any power movement the body makes.

In skiing, of course, the “tilt” is not forward and under, as in weight lifting, but rather up in the pelvis, softly but radically over in the shoulders, a stabilizing and dynamizing attitude critical to the body's ability to accept high track speeds – up in the legs, over in the shoulders!

A final comparison of approaches to the glide to lift-off motion needs to be mentioned. A bent knee, scoop through motion forces the skier to stabilize and re-lift with muscle power, as I have already suggested. But the total lift-off sequence is needlessly complicated as well. In order to lift the body back into a high enough position from which a new leg compresson-rebound can take place, *two* motions must be made: up then down. If the skier is already relaxing on a basically straight leg over his balance point (on bone rather than muscles), the compression can be accomplished simply with *one* motion, a collapse of the body weight down the leg. One costly and wasteful motion is easily eliminated.

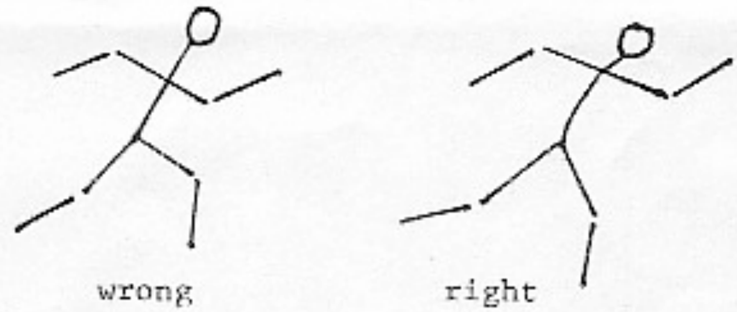


Figure 7.

The bent knee glide position also produces what I would call a static or neutral relation between the center of gravity and he glide attitude of the ski in the track. Throughout the glide itself the speed actually slows, that is, the stride "dies" to a degree before the next picks up the speed again. In the bent knee attitude the body stays "heavy," dead on the forward ski and essentially remains in a set position until the up-down motion of the next lift-off. The pressure of the body weight is maintained somewhere on the forebody of the ski. As the stride dies, therefore, this static weight increases the plow tendency of the ski.

The ballistic efficiency of the up and over curve keeps the glide more "alive." The skier lifts immediately onto a straightening lead leg, even before the point when the new glide ski touches the snow. In other words, at the point at which the stride begins to die, the up-motion of the body weight tends to move it progressively backwards from the forebody of the ski, thus freeing the ski. Instead of die-out, the skier maintains a more sustained flotation of the ski; his momentum is continued without additional movement or effort as he follows the soft, continuing rise of the lift-off.

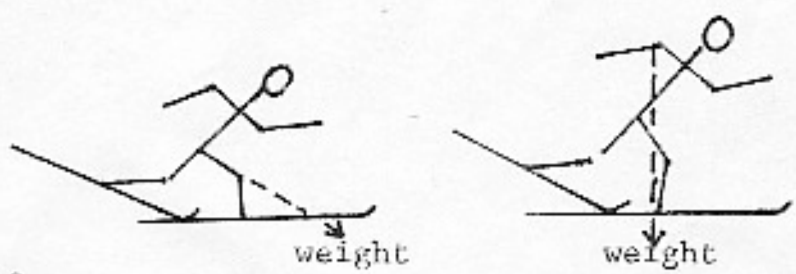


Figure 8.

Two efficiency plusses have been gained: one motion is totally eliminated, and momentum is preserved simply by letting the body's instinctive ballistic inclinations respond freely to the whole-situation of body weight-speed-terrain.

Center of Gravity Speed vs. Frequency of Movement

Implied throughout the foregoing discussion is the essential principle that speed across the snow must be perceived as the speed of the skier's center of gravity, or total speed. The add-on approach to separate elements of technique frequently has lead to the conclusion that speed is produced through the fastest possible sequencing of those separate movements. But approaching speed through frequency of movement (though they are obviously related) makes as little sense as suggesting that second gear, because of its high rpm's will automatically produce greater speed.

The difference in speed will therefore be made by a perception of what the whole-character of skiing movement by coach and athlete, what amounts to a mental set which allows natural movements and inclinations to refine themselves to a point of nearly thoughtless efficiency and grace, rather than by the calculated addition of separate elements. One might even say that good technique is achieved through a process of subtraction of needless efforts (not to mention thought itself). What is ultimately left to the skier is a clear mind, open senses in a single motion which is totally integrated, flexible to terrain changes and effective.

Terrain Changes

Since from the whole-perspective we view cross-country technique as an instinctive extension of foot running, there are no new truly new movements to learned or think about as terrain change are encountered. In fact, the "what do I do now?" approach is the single most drastic cause of momentum loss because by the time the skier thinks about what to do, at the beginning of a climb, for example, it is too late. The hill has risen in front of him suddenly (while he was thinking what to do next) and brought his flat stride to a virtual stand-still. Even with B-level elite skiers, this mistake is observable: they ski too far into the hill with long strides, and they try to return to those long strides too soon at the top of the hill. The result is inefficient and a strain on their physical resources. If the skier lets the terrain set the frequency of movement, attending only to preserving his momentum, kinetic impulse, he will instinctively "downshift" not a gear or two but three or four. He will literally run up the hill and away from it, softly, precisely, and without excess power drain. The point again is this: if he thinks less about the fact that he is skiing and more about simply moving, maintaining the continuum curve of forces, he will move both more swiftly and more easily.

I am not saying that there will never be terrain features where the skier won't have to simply "muscle it," particularly in the shoulders and arms on a very steep climb. I am saying that the body works best if allowed to deliver its strength by itself. The best the skier can do is concentrate on relaxing, moving always "soft" and "up."

Conclusion

The whole-to-parts perspective improves efficiency and speed by drastically simplifying technique. It is a perspective which focuses the skier's senses far ahead of is actual location on skis but in precise relation to his position as a dynamic whole-speed profile. The skier may then take advantage of a natural up-and-over flight attitude which develops out of the body's feel for efficient (graceful) flow movement. To do so he needs to do nothing more than go directly to our natural animal inclination to run, propel ourselves over the ground. A collapse. compression-rebound/lift (plyometric effect) produces a float attitude with bone support, a launch force which is able to convert static body weight into momentum "pull" according to the laws of kinetics and ballistics.

1. Plyometric effect. Cf. "How to Maximize Running Efficiency," by Kris Berg, *Runner's World*, April, 1979, p. 51. "It may be the timing element of muscle forces which most readily distinguishes the excellent from the good runner. Precise timing of hip, knee, ankle, and arm movement allows the runner to make use of the elasticity inherent in muscle tissue. Because a

stretched muscle automatically rebounds to its original length, it has the capacity to do 'free' work and so increase the force, power and efficiency of our movements. Physiologists believe that elastic energy may produce as much as 50% of the total energy used to do work. So failure to make maximal use of this elastic energy is highly wasteful."

2. *Op.Cit*. "Many novice runners have a tendency to overstride. Overstriding results in the lead foot hitting the ground ahead of the center of gravity, producing a momentary halt to forward progress. The recovery leg must then apply extra energy to re-accelerate the body, making such running appear jerky rather than smooth and flowing."