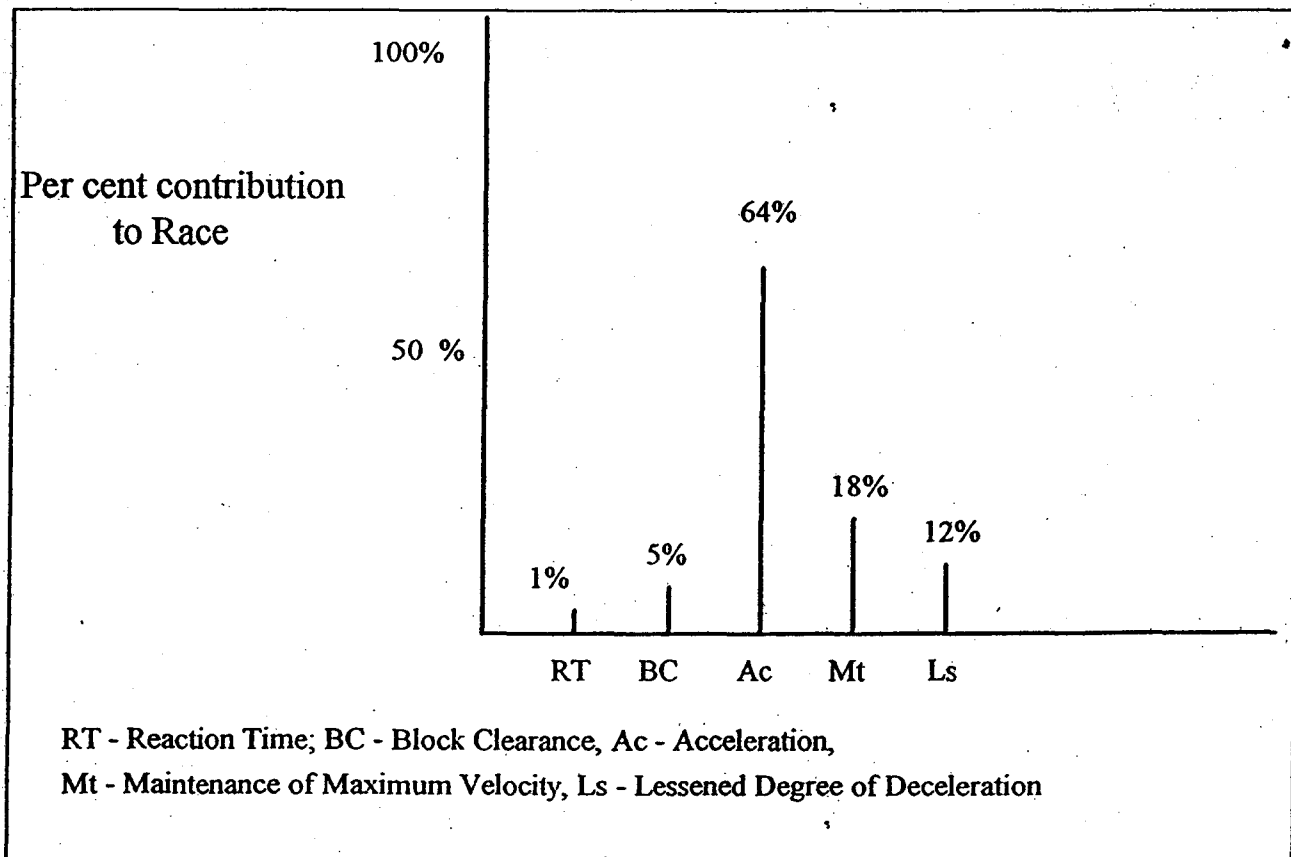


SPRINTING - FROM START TO FINISH

by
Tom Tellez - University of Houston

Regardless of ability, in order for an athlete to reach his maximum potential as a sprinter, his training should center around these factors: Reaction Time, Block Clearance, Speed of Efficient Acceleration, Maintenance of Maximum Velocity and Lessened Degree of Deceleration.

Based on a 10.0 second 100 meter dash, a breakdown of the race allows an estimated distribution of each of the factors in the following graph. (It should be noted that efficient acceleration over the longest possible distance is influenced by the position of the body as the athlete leaves the blocks. Therefore, block clearance may be thought of as contributing much more to the total race than 5%. The block clearance "sets up" the acceleration pattern of the race.)



100 meters

Stride	1	2	3	4	5	6	7	8	11	12	13	.....	30	.....	45
Distance in meters	0	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60-70	.....	100

Total forces are the combination of vertical and horizontal forces.

Force (ver.) At the beginning the vertical force is equal to the horizontal because of the 45-degree angle of projection. The force shift quickly to predominately vertical as the body becomes more upright. First, the vertical has to be greater than gravity in order for contact to be broken with the ground. Vertical forces continue through out the race.

Force (hor.) The horizontal forces are established at take off and determine the changes in Horizontal velocity. Horizontal forces start out big but get smaller as the body picks up speed and approach top speed. At top speed the net horizontal forces are zero. After top speed is attained, the horizontal forces increase negatively which causes the body to slow down.

Time: At the beginning of the race, the first stride is the slowest. The stride gets progressively faster as momentum is built. Time diminishes with speed as contact time

decreases. Stride time should be fastest as the athlete approaches top speed then levels off and increase as fatigue set in during the deceleration phase.

Changes in p : Changes in momentum is directly related to the impulse imparted to the system.

Changes in v : Changes in velocity is the result of a mass being accelerated for some given time. In sprinting, the mass is accelerated upward. How long (the time) the mass spends accelerating is directly proportional to the changes in velocity (speed). As force is applied the mass, it picks up speed until the net horizontal forces become zero. At this point, there is no change in velocity (top speed). As the net horizontal forces become negative, the mass slows down. The changes in velocity are cumulative which results in an ending velocity.

Momentum: Momentum increases with each positive change in velocity until full speed is attained. It levels off at top speed and then slightly decreases towards the end of the 100 meters. The changes start out big because the body has to overcome inertia or its rest state but decrease as they approach zero towards 60-70 meters depending on the race plan. After top speed is held for a brief period, the changes begin to grow negatively at an increasing rate.

Acceleration grows at a decreasing rate until it approaches zero. The biggest gains are at the start of the race then get smaller as top speed is approached at which time acceleration become zero then shift to negative at the onset of fatigue.

The human body act under the influence of projectile motion once launched from the ground during sprinting

The path that a projectile (body) follows is called its trajectory. There are two components of projectile motion so it is useful to consider the vertical (y) and horizontal (x) of the velocity and displacement separately. With each launch, projectile travels at a constant horizontal velocity. This horizontal motion depends on the horizontal component of the initial velocity at take off. Hence the distance traveled will be the initial velocity times time.

The vertical motion of a projectile depends on the vertical component of the initial velocity and on the acceleration due to gravity. A projectile will follow a parabolic trajectory unless it projected completely vertical 90 degrees

Above, there is a description of the motion. Now let's take a look at what causes the motion. To get the body (center of gravity) to travel along a trajectory,

requires that an impulse (force times time) be applied to the object's x or y of m . This impulse directly changes the velocity of the center of mass. To get the largest possible impulse requires the athlete either applies the largest possible force, applies the force for the longest possible time or both.