

Neuro-Biomechanics of Maximum Velocity Running Mechanics

Loren Seagrave
Director of Speed and Movement
Director of Track & Field and Cross Country

Epistemology (Relative Truth)

One of the areas in Philosophy that Deals with the Nature and Scope (Limitations) of Knowledge

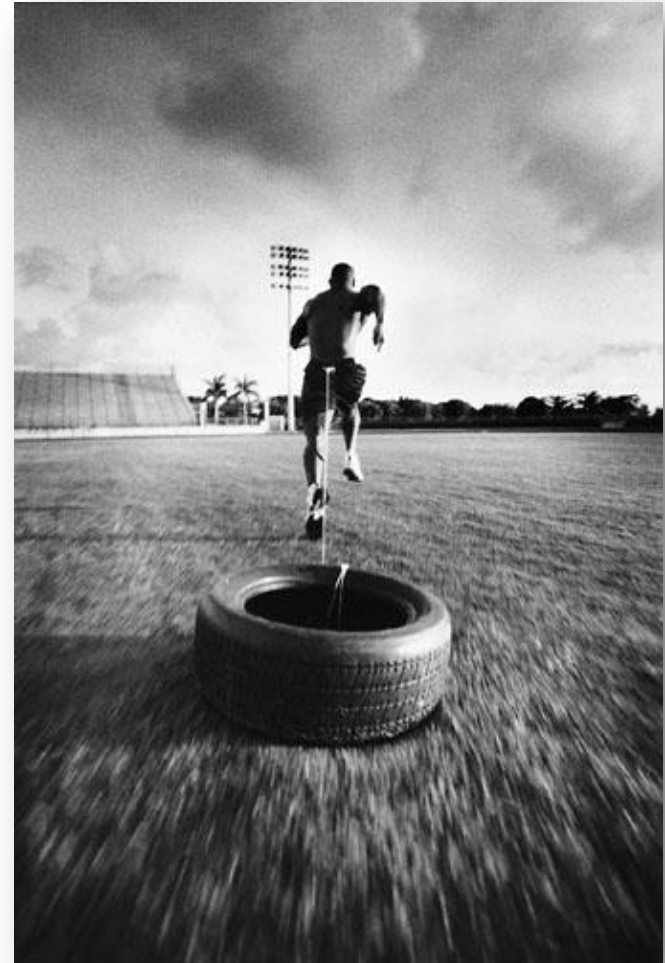
Implications of the Relativity of Truth

The theory of the nature and grounds of knowledge, especially with reference to its limit and validity

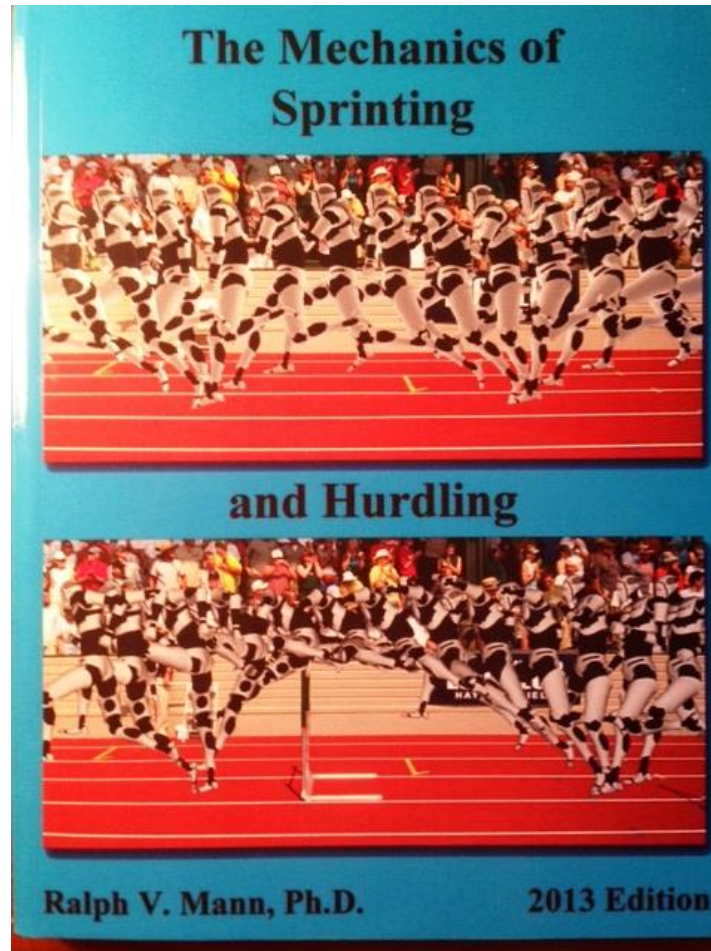
Reaction to “New Truth”

Adapted from Kubler-Ross Model

- » Shock
- » Disbelief
- » Ridicule
- » Denial
- » Anger
- » Sometimes Bargaining followed by Depression
- » Acceptance



Latest Work by Dr Ralph Mann



Athlete's Conceptual Model

The Athlete's Mission Statement

Reduce the Time Required to Apply the Necessary Force to the Ground by 0.005 Seconds

Reduce the Time Required to Recover the Leg Through the Full Range of Motion by 0.005 Seconds



The Athlete's Daily Plan of Action

The Athlete's Goals: Accomplished in Four Ways

Produce a Greater Force

Produce the Force in Less Time

Produce the Force in the Proper Direction

Produce the Force Through Optimal ROM

Neuro-muscular Control

Recruitment Strategies to Enhance Speed

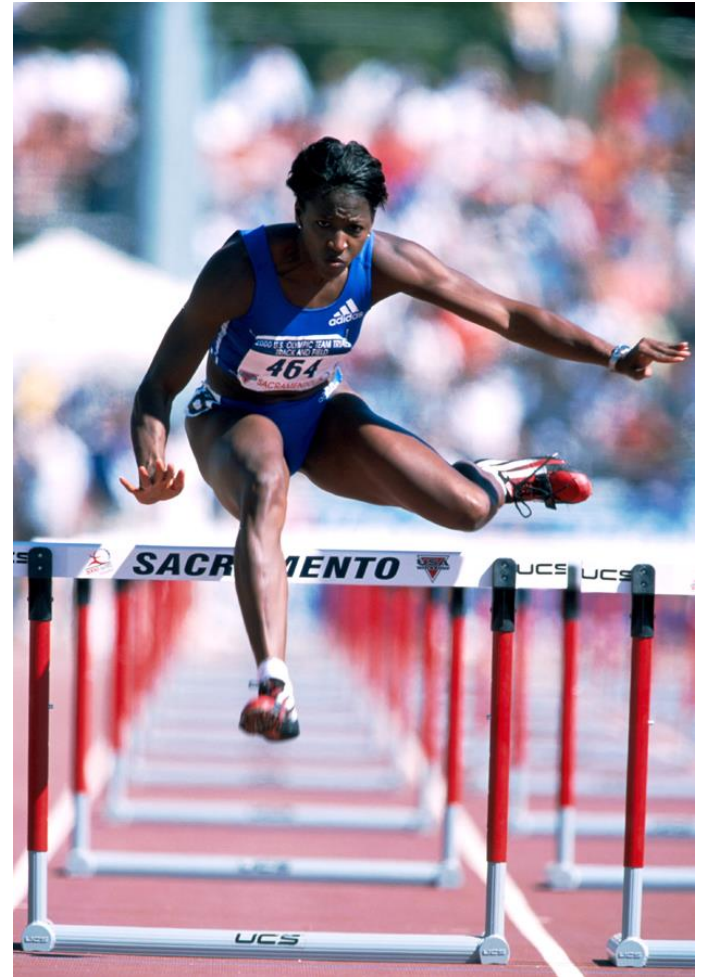
Sequencing - Order of Recruitment

Timing

Intermuscular Coordination

Intramuscular Coordination

Synchronization



Muscle Contraction Characteristics

Slow Twitch versus Fast Twitch

Contractile versus Elastic

Joint Stabilization

versus Body Propulsion



Neuro-muscular Control

***Joint Position Dictates
Muscle Recruitment***

Neuro-muscular Inhibition

Neuro-muscular Facilitation

Neuro-mechanical Advantage



Understanding Velocity

Velocity is Product of:

Stride Length

Stride Frequency

$$\text{Velocity}_{\text{m/sec}} = \text{SL}_{\text{meters}} \times \text{Sf}_{\text{step/sec}}$$

$$\text{SL} = \text{Velocity} / \text{Sf}$$

Understanding Stride Length

Actual Stride Length

Point of Touchdown on Right Foot to
Point of Touchdown on Left Foot

Effective Stride Length

Center of Mass at Take-Off

Center of Mass at Touchdown

Understanding Stride Frequency

Elite Sprinters

Ground Time 0.08 seconds

Air Time 0.12 seconds

Stride Time 0.20 seconds

Stride Frequency 5.0 step/second

Understanding Stride Frequency

Developing Sprinters

Ground Time 0.12 seconds

Air Time 0.13 seconds

Stride Time 0.25 seconds

Stride Frequency 4.0 step/second

The Six Foci for Modifying Sprint Mechanics

Body Position Focus

Recovery Mechanics

Transition Phase

Ground Preparation

Ground Phase

Arm Action

The Six Foci: Body Position

Body Position Focus

- Draw-in & Brace
 - Tummy Tight
- Posture Realignment
 - Back flat
 - Butt tucked under
 - Pelvis looking up
- Longitudinal Alignment



Traditional View of Running Mechanics

Two Phases of Sprint Stride

- Drive Phase
- Swing Phase
- Lift Phase

Reframing View of Running Mechanics

Quality of a Phase of Running Mechanics

Determined by the phase that immediately precedes it.

Most Important Phase of Running

Where to Begin

The Six Foci: Recovery Mechanics

Residual Phase

- Begins at take-off
- Ends with positive acceleration of the thigh

- **Recovery Phase**

- Begins with positive acceleration of the thigh
 - **Hip Flexion**
- Ends with the blocking of the thigh
 - Complete deceleration of the thigh



The Six Foci: Recovery Mechanics

Recovery Mechanics (Residual Phase) Cues

- Proper body position
- Toe-up, Thigh Pop, Lift Heel Forward
- Recovery Mechanics (Recovery Phase) Cues
 - Proper body position
 - Toe-up, Thigh Pop, Lift Heel Up
 - Step-over the opposite knee (Tony Wells)



Passive and Active Insufficiency

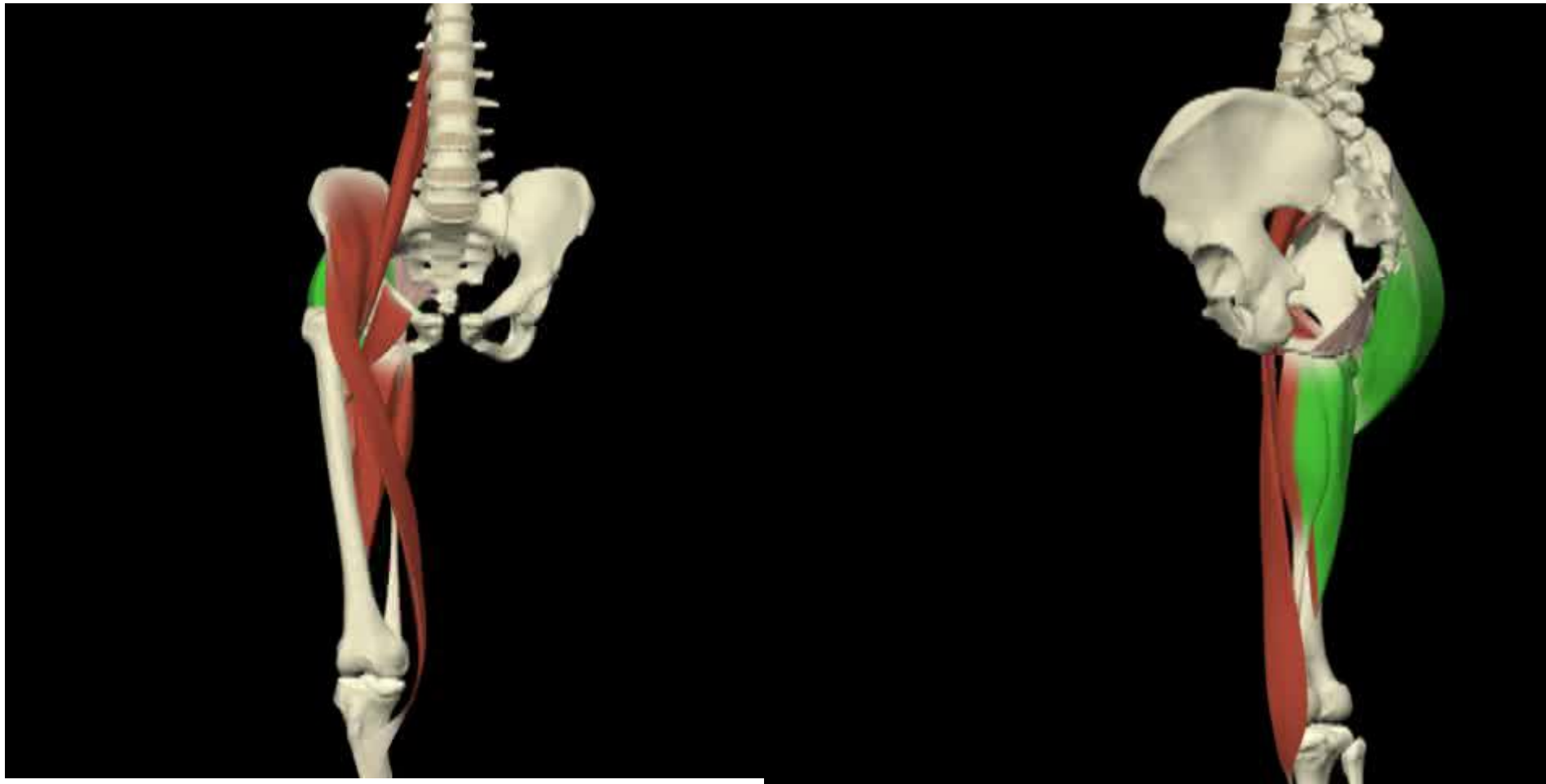
One Joint Hip Flexors

- As the muscle shortens it loses mechanical advantage
- Iliacus, Psoas, Pectineus, Gluteus Medius

Two Joint Hip Flexors

- One joint must be relatively fix and other moves
- Sartorius, Tensor Fascia Lata, Rectus Femoris

Passive and Active Insufficiency-Hip



Passive and Active Insufficiency-Knee



The Six Foci: Transition

Transition Phase

- Begins with the blocking of the thigh
- Ends with negative acceleration of the thigh



The Six Foci: Transition

Transition Phase Cues

- Eliminate the turnaround time
- Block the thigh, change directions



The Six Foci: Ground Preparation

Ground Preparation

- Begins with negative acceleration of the thigh
- Ends with touchdown of the foot

The Six Foci: Ground Preparation

Ground Preparation Cues

- Active thigh back
- Loose knee joint, toe-up
- Stabilize knee with co-contraction
- Grab the foot under the body

The Six Foci: Ground Phase

Frontside Mechanics (Impulsion) Cues

- Explode through the ground
- Tear back the track

Mid-Stance

- Firm Leg



The Six Foci: Ground Phase

Frontside Mechanics (Impulsion) Cues

- Explode through the ground
- Tear back the track



Backside Mechanics (Propulsion) Cues

- Push through the ground

The Six Foci: Arm Action

Arm Action Cues

- Backward elbow drive, only
- Thumbs up, palms facing in, hands open
- Hammer the hands back (Kevin McNair)

Sprint Drills

- **Ankling**
 - Proper body position,
 - Foot dorsi-flexed
 - Load the ankle elastically on the ball of the foot under the hip



Sprint Drills

- **Butt kicks**

- Proper body position
- Foot dorsiflexed
- Flick the heel-up, rapid fire



Sprint Drills

- **Butt kicks with Thigh Pop**

- Proper body position
- Foot dorsiflexed
- Pop the Thigh
- Lift the heel-up Forward



Sprint Drills

- **Side Lying Recovery (recovery focus)**
 - Lie on your side with the body in a straight line
 - Foot dorsi-flexed
 - Heel-up, knee-up together
 - Step over the opposite knee



Sprint Drills

- Standing Recovery
(recovery focus)

- Standing supported with one hand, proper body position
- Foot dorsiflexed, toe-up, heel-up, knee-up together
- Step over the opposite Knee



Sprint Drills

- **Vmax A-March,
Vmax A-Skip
(Recovery Focus)**
 - Foot dorsi-flexed
 - Heel-up, knee-up together
 - Step over the opposite knee



Sprint Drills

- **Step Over Run
(Recovery Focus)**
 - Foot dorsi-flexed
 - Heel-up
 - Step over the opposite knee



Sprint Drills

- **Step Over Run
(Recovery Focus)**
 - Foot dorsi-flexed
 - Thigh Pop
 - Heel-up
 - Step over the opposite knee



Sprint Drills

- **Fast Claw**

- Ready Position
 - Step Over Position
- Initiation
 - Thigh Extension
 - Knee Joint Relaxed
 - Ankle Dorsiflexed
- Execution
 - Fix Knee Joint
 - Ball of the Foot Landing
- Completion
 - Active Recovery Action



Sprint Drills

Vmax A-March, A-Skip (Ground Preparation Focus)

- Grab the foot under the body



Sprint Drills

Long Backward March, Skip and Stride

- Perfect sprint mechanics backwards
- Toe-up, knee-back, heel-up
- Step back through the window
- Grab the foot under the body

Sprint Drills

- **Shake-ups**

- Foot dorsi-flexed
- Body lean from the ankles
- Recover the thigh elastically
- Pull the straight leg behind the body
- Load the ankle elastically on the ball of the foot



Sprint Drills

- **Straight Leg Shuffle**
 - Foot dorsi-flexed
 - Leg is like a long iron rod, no knee joint
 - Grab the foot under the body



Sprint Drills

- **Straight Leg Bound**
 - Foot dorsi-flexed
 - Leg is like a long iron rod, no knee joint
 - Grab the foot under the body
 - Maximize hip projection



Sprint Drills

Single Leg Skills (General Cues)

- Execute proper recovery mechanics
- Block the thigh, grab the foot under the body
- Very active thigh back

Sprint Drills

- **Fast Leg Routine
(Right and Left)**



Sprint Drills

- **Alternate Fast Leg Routine**



Sprint Drills

- Double Fast Leg



Sprint Drills

- **Alternate Double Fast Leg**



Sprint Drills

- Continuous Fast Leg



Sprint Drills

- **Straight Leg Bound /Fast Leg**
 - Begin straight leg bounding
 - Add fast leg routines
 - Single fast leg



Sprint Drills

- **Straight Leg Bound/
Fast Leg**
 - Begin straight leg bounding
 - Add fast leg routines
 - Alternate fast leg



Sprint Drills

- **Straight Leg Bound/
Fast Leg Into A Step-
Over A-Run**