Welsh Athletics Coaching Conference 2017

The Science Behind Sprinting

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Initial Acceleration Phase
Transition Phase
Maximal Velocity Phase
**Transition Phase: Descriptors**

- **Duration:**
  - 5/10 – 20/35 m
  - ~Steps 4/6 to 13/16
- **Characteristics:**
  - ↑Velocity (0.19 - 0.28 m/s per step)
  - < 92% to 98% of maximal velocity

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**Step Length**

- ↑Step length

**Step Frequency**

- Step frequency should be maintained
Transition Phase

- Decreasing in body lean: 1° per step
  - Facilitates vertical force application

- Better performers had increased toe-off body lean
  - ↓ propulsive forces generated

- Higher performance associated with lower braking impulse & higher propulsive forces
  - Front side mechanics play an important role in minimising Braking forces
  - Larger increases in velocity associated with increased body lean at toe-off
Transition

Begins when shin angle is perpendicular

Science tells us:
  - Torso angle raises approx. 2-3° per step
  - Shin angle approx. 6-7° change per step

Steps/time or distance trunk rises to upright

Use steps rather than distance

Difficult to coach in isolation

Limited ‘drills’ can be used

<table>
<thead>
<tr>
<th>Step</th>
<th>Shin Angle (6-7°)</th>
<th>Trunk Angle (2-3°)</th>
<th>Step</th>
<th>Trunk Angle (2-3°)</th>
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Marching drills
Rhythm runs – easy accels
“push, push, push, Stand up tall (gradually)”
Initial Acceleration Phase
Transition Phase
Maximal Velocity Phase
Maximal Velocity Phase: Descriptors

- **Duration:**
  - 20/35 m until maximal velocity
  - ~Step 14/17 until maximal velocity

- **Characteristics:**
  - \( \uparrow \) Velocity (0.01 - 0.06 m/s per step)

- Relatively small changes in either step length or step frequency
Maximal Velocity Phase

- Stabilisation of Posture
- High velocities sprinting associated with high vertical forces & lower contact times \(^{(5,9)}\)
- Further increases in velocity dependent on ability to minimise braking forces \(^{(5,8)}\)
  - Front side mechanics
    - Braking impulse increases with ↑ touchdown distance and ↑ Foot speed \(^{(8)}\)
Front side mechanics: TD distances

Increases step length & front side leg range of motion to generate force \(^{(2)}\)
Front side mechanics: Relative muscle forces

- **HIP EXTENSOR** and **KNEE FLEXOR** muscle forces increase \(^{(8)}\) - generate larger forces and accelerates the sprinter over their contact point \(^{(8)}\).

- **PLANTAR FLEXOR** muscle forces - transmit force to the ground \(^{(8)}\)
  - Increasing **PLANTAR FLEXOR** muscle forces –resist increasing external forces \(^{(8)}\)
High Speed Running (maximum velocity)

- Posture; preserve stability

- Vertical force production
  - Ground contact position (minimise braking forces)
  - Better maintenance of momentum
  - Greater displacement

- Elbows in front of the body
  - Hip & shoulder rotations

- High hips
  - Stiffness – foot/ankle, knee (avoid collapse)

Cues
- Step over the opposite knee
- Step down into the track
- Run through the long grass
- Run tall
Importance of Posture

- Limb movement originates from the core
- Core needs to be stable and properly aligned for efficient movement and enable maximum transfer of force

1. Excessive trunk lean
2. Pelvic rotation (anterior)
3. Reduced knee lift
4. Inhibits vertical force production
5. GC in front of body - Increase braking force
6. Longer ground contact
7. Excessive rear side action
Sprinting

“A series of cyclical movement phases, these occur over and over and over again throughout the course of a race”
Residual Phase – The moment the toe leaves the ground (T.O) until the thigh begins moving forward in recovery

Recovery Phase - From the moment the thigh begins moving forward until the thigh stops (blocking)

Transition Phase – From the moment the thigh blocks until the thigh begins to accelerate in a negative direction.

Ground Preparation Phase – From the acceleration of the thigh in a negative direction until touch down (T.D.).

Frontside Ground Phase – From the instant of T.D. until the COM is over the base of support (contact point of foot).

Backside Phase – From the mid-stance of support over the foot until the Take off (T.O.) into the next Residual Phase.

Seagrave, 2009
Dribbles

- Full foot contact
- “ankling” ball of foot, elastic rebound – issues?
  - Forefoot
  - Shin
  - Patella

Variations
- Ankle
- Calf
- Knee
- Medium and fast

“Dribbling is a way to modify gait. Usually injuries are specific to force/velocity factors, so if you modify gait, often the injury does not flip to a guarded state.”

Pfaff

“Dribbles are a contextual drill that teach the athlete to push vertically. If the foot travels in a circle, vertical force has to be spot on.”

Pfaff