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The Limits of Running Speed







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The Limits of Human Performance
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Kinesiology

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Top Running Speeds

▪ Turtle*	0.1 m/s (0.2 mph)	
▪ Domestic Pig	5 m/s (11 mph)	
▪ Human	12 m/s (27 mph)	
▪ Greyhound	18 m/s (40 mph)	
▪ Quarter Horse	20 m/s (45 mph)	
▪ Pronghorn	25 m/s (56 mph)	
▪ Cheetah	30 m/s (67 mph)	




 "not really 'running'"

The Limits of Human Performance 2

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Top Speed by Form of Locomotion

- On Land
 - Running: cheetah 30 m/s (67 mph)
- In Water
 - Swimming: sailfish 31 m/s (70 mph)
- In Air
 - Flying: swift 47 m/s (105 mph)
 - Diving: peregrine falcon 89 m/s (200 mph)

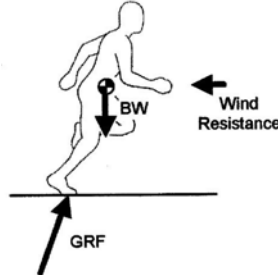




The Limits of Human Performance 3

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Mechanics of Running

- Forces acting on runner
 - body weight
 - ground reaction force
 - wind resistance
- Two key tasks
 - generate forces against the ground
 - swing the leg forward for next step



Hunter et al, 2005

The Limits of Human Performance 4

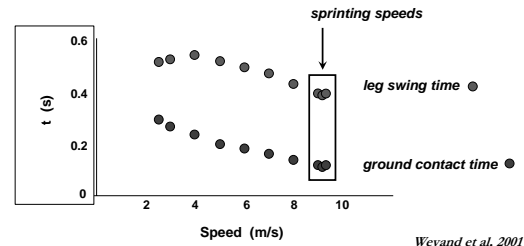
What Limits Human Running Speed?

Two prominent theories

- Inability to generate greater forces against the ground
- Inability to swing the leg forward faster
- Both are related to the decreasing time available as we increase running speed

Ground Contact and Leg Swing Times

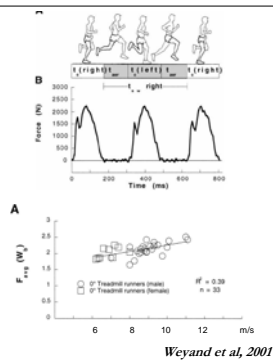
- As you run faster, the amount of time available to swing your leg and generate force against the ground both decrease



Weyand et al, 2001

Generating Forces Against Ground

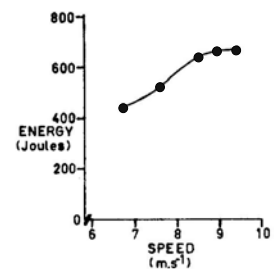
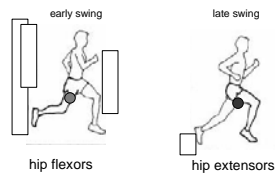
- Running faster requires generating larger forces against the ground
- Runners who can go ~ 11 m/s generate 1.25x greater forces on the ground than runners who can only go ~ 6 m/s
- Represents a limitation in both the *speed* and *magnitude* of muscle contraction



Weyand et al, 2001

Leg Swing

As runners reach their top speed, the energy delivered to their swing leg reaches a plateau; may reflect a limitation in the muscles that accelerate the brake the swing leg



Chapman & Caldwell, 1983

Running Faster?

What would be necessary for humans to run faster than they currently do?

1. Stronger muscles (more force)
2. Faster muscles (related to fiber type)
3. More powerful muscles (combines 1 & 2)
4. Lighter legs (is this possible with #1?)
5. Anything else?

Up next ...

- Factors that limit human endurance running performance