

Film Group

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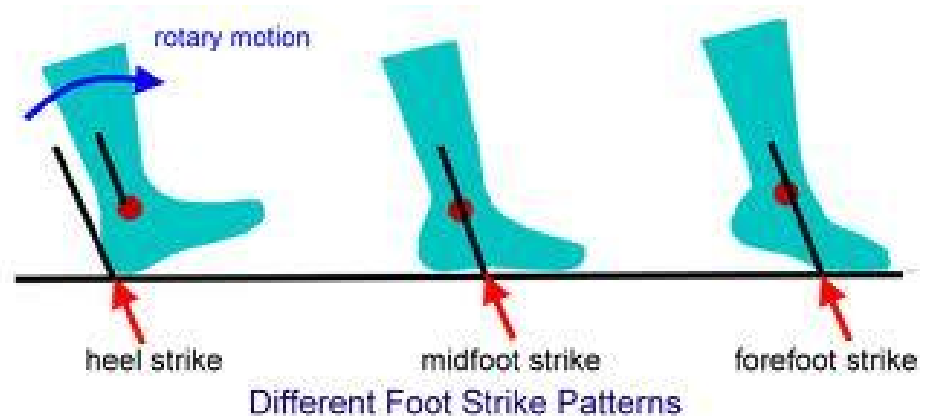
Research Questions

Are the faster runners the ones with a longer stride or a shorter stride?

What is the connection between gender, footstrike and performance?

What role does stance time play in this race?

Does speed predict foot strike?



Why We Care



Extrapolate how we ourselves can improve as runners.

Separate bad running behaviors from good ones.

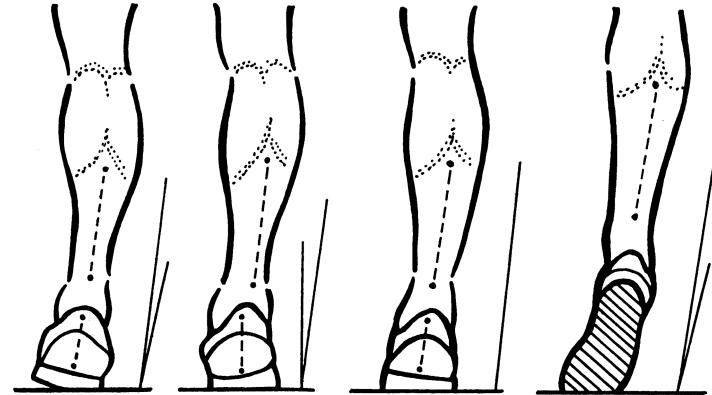
Understand what roles different variables play in our running ability..

Larson, Novacheck, and Mcdougall

An increased speed should result in less time spent in contact with the ground as well as more of a toeing off of the ground.

The vast majority of runners are rear strikers. Most people that start off at 10k on their fore or mid foot, will go to a heel strike as fatigue sets in by 32k.

The cushioning that is provided on the backs of the shoes creates a rear-striking tendency that is harmful to runners.



Understanding of the Data

We attended the Spring Tune-Up Road Race for the Atlanta Track Club.

The camera was placed an adequate distance away from the runners and set to a frame rate of 240 fps so that we could capture not only their whole body, but also get a clear view of their stride length, rate and landing position.

→ We placed a high-speed camera five kilometers into a mixed race of both eight and fifteen kilometer runners.

↙
→ The width of the camera angle was roughly 10 ft and we recorded the passing of 592 runners in the race (1033 participants in total).

Approximating Race Population

Multiple locations, Lack of elites, Low # of participants



Methods



One percent sample, Use of timestamps, Comparison to actual finish time, Attempt to cover overall population.

Total Footstrike Data

| Foot Strike | Number |
|-------------|--------|
| FFS: | 0 |
| MFS: | 26 |
| RFS: | 34 |
| Total | 60 |

1033 Total Participants

3+ hours of 240 fps video

Wanted 1% of total participants

Every 10th person was documented

Recorded footstrike and gender at specific time stamp

Reliability

| Timestamp | Matt Cole | Sam | Charles | Josh | Percentage Agreement |
|-----------|-----------|-----|---------|------|----------------------|
| 1:52:00 | MFS | MFS | MFS | RFS | 75% MFS 25% RFS |
| 6:11:00 | RFS | RFS | RFS | RFS | 100% RFS |
| 8:59:00 | MFS | MFS | MFS | MFS | 100% MFS |
| 9:59:00 | MFS | RFS | RFS | MFS | 50% MFS 50%RFS |
| 11:05:00 | FFS | FFS | FFS | FFS | 100% FFS |
| 14:38:00 | RFS | RFS | RFS | RFS | 100% RFS |
| 17:25:00 | RFS | RFS | RFS | RFS | 100% RFS |
| 25:00:00 | RFS | RFS | RFS | RFS | 100 % RFS |
| 31:57:00 | RFS | RFS | RFS | RFS | 100% RFS |
| 34:22:00 | MFS | MFS | MFS | MFS | 100% MFS |

Footstrike Examples



Front Foot Strike



Mid Foot Strike

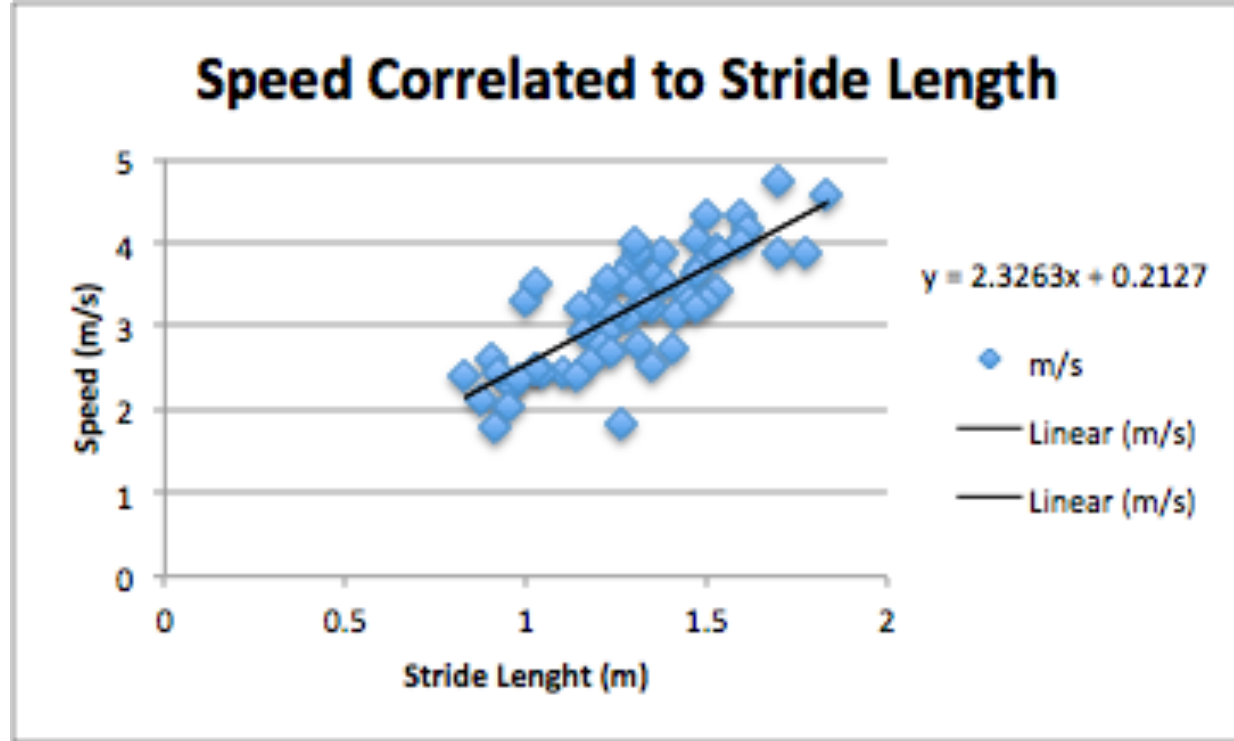


Rear Foot Strike

Research Question 1

Are the faster runners the ones with a longer stride or a shorter stride?

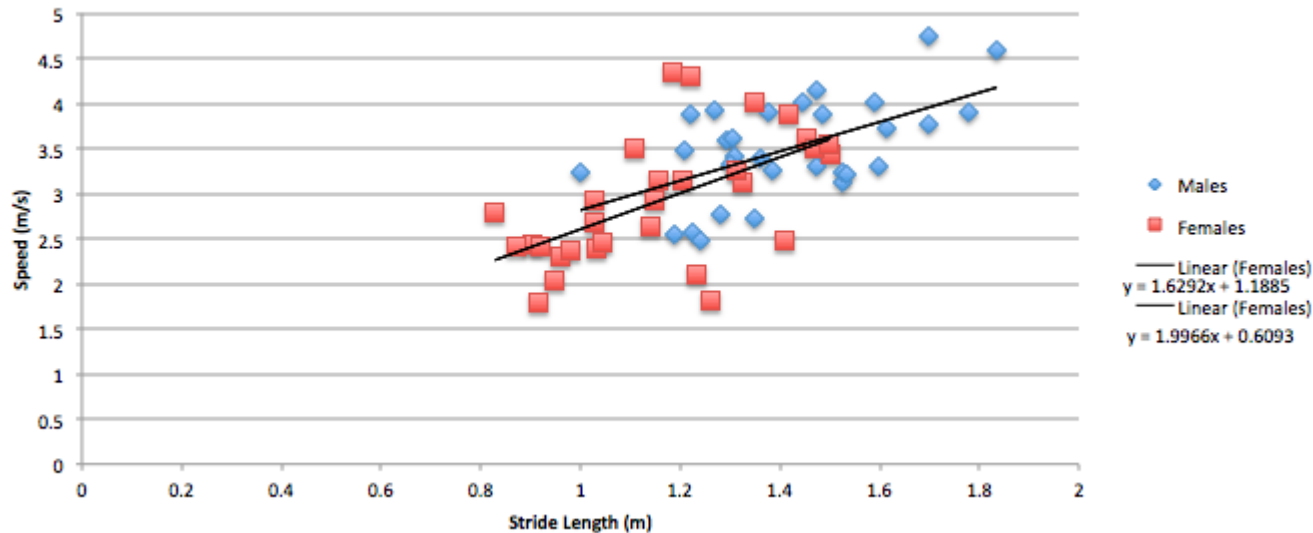
Stride Length and Speed are Correlated



Faster runners have a greater stride length.

Stride Length and Gender

Stride Length Correlated to Speed by Gender



| | Male | Female |
|---------------------------|---------|---------|
| Average Stride Length (m) | 1.41945 | 1.16128 |
| Average Speed (m/s) | 3.50115 | 2.92787 |

Research Question 2

What is the connection between gender, footstrike and performance?

Footstrike Between Gender

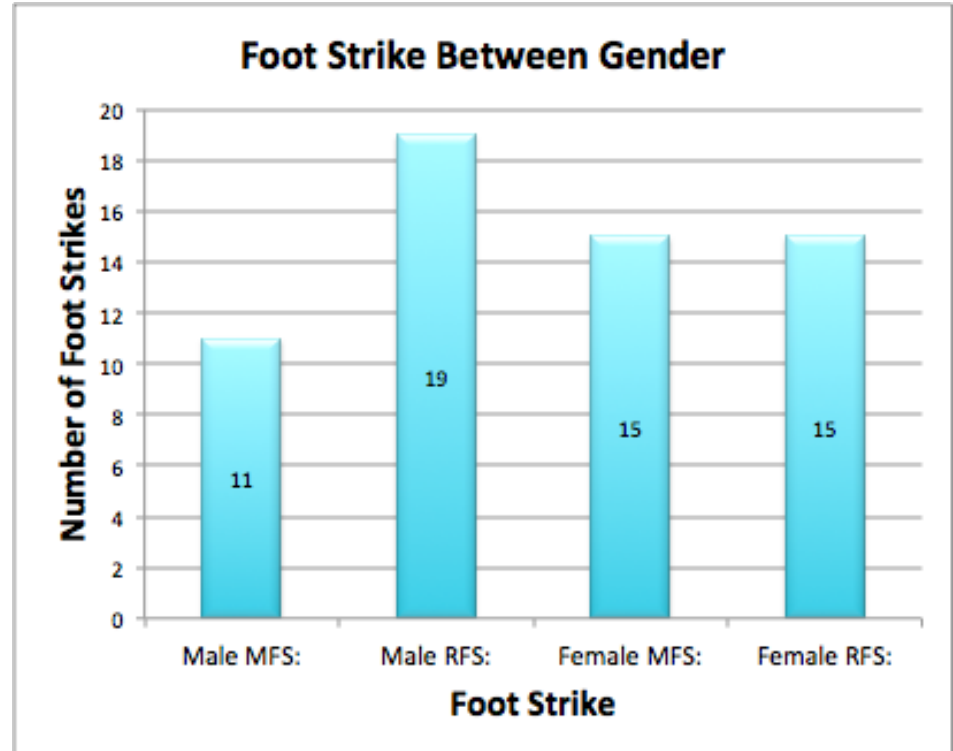
| Foot Strike | Male | Female | Percent |
|-------------|------|--------|---------|
| MFS: | 11 | 15 | 43.33% |
| RFS: | 19 | 15 | 56.67% |
| Total | 30 | 30 | 100.00% |

Only had ~600 participants on film

50% men and 50% women

Difference between gender

Males lean more towards RFS



Footstrike In Gender/Performance

| Male Top 10 | Number | Percentage |
|-------------|--------|------------|
| MFS: | 3 | 30% |
| RFS: | 7 | 70% |
| Total | 10 | 100% |

| Combined Top 10 | Number | Percentage |
|-----------------|--------|------------|
| MFS: | 4 | 40% |
| RFS: | 6 | 60% |
| Total | 10 | 100% |

| Female Top 10 | Number | Percentage |
|---------------|--------|------------|
| MFS: | 7 | 70% |
| RFS: | 3 | 30% |
| Total | 10 | 100% |

| Combined Top 20 | Number | Percentage |
|-----------------|--------|------------|
| MFS: | 8 | 40% |
| RFS: | 12 | 60% |
| Total | 20 | 100% |

Footstrike In Gender/Performance

| Male Bottom 10 | Number | Percentage |
|----------------|--------|------------|
| MFS: | 5 | 50% |
| RFS: | 5 | 50% |
| Total | 10 | 100% |

| Combined Bottom 10 | Number | Percentage |
|--------------------|--------|------------|
| MFS: | 3 | 30% |
| RFS: | 7 | 70% |
| Total | 10 | 100% |

| Female Bottom 10 | Number | Percentage |
|------------------|--------|------------|
| MFS: | 3 | 30% |
| RFS: | 7 | 70% |
| Total | 10 | 100% |

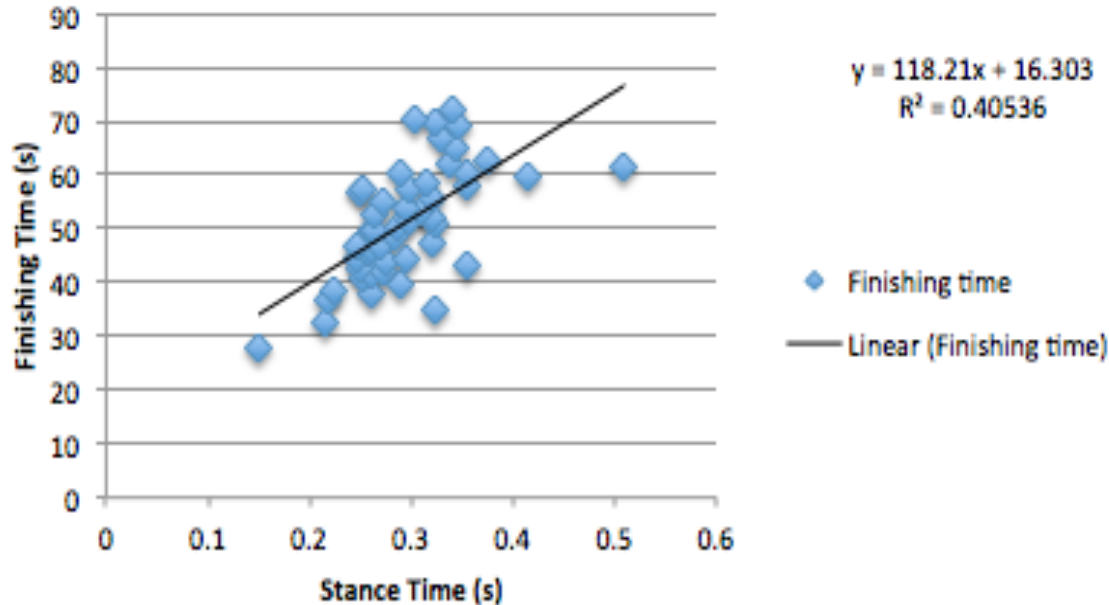
| Combined Bottom 20 | Number | Percentage |
|--------------------|--------|------------|
| MFS: | 9 | 45% |
| RFS: | 11 | 55% |
| Total | 20 | 100% |

Research Question 3

What role does stance time play in this race?

Stance Time as a Way to Predict Finish Time

8k Finishing Time vs Stance Time



50 runners matched up with finish time in 8k.

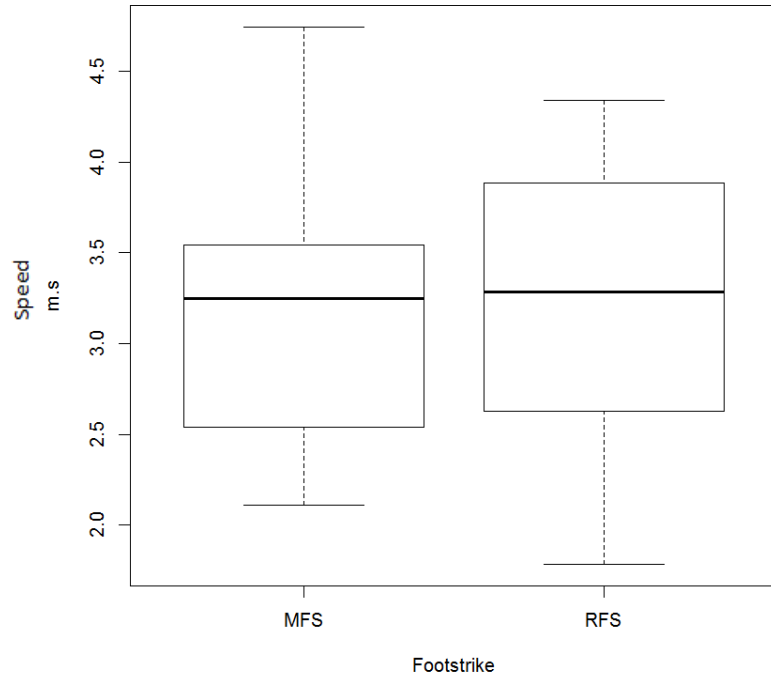
Recorded stance time then divided by frames per second as compared to normal.

Stance time as clear indicator of speed and performance.

Research Question 4

Does speed predict footstrike?

Footstrike is Not Associated with Speed



Two Sample t-test

Data: Speed (m.s) by Footstrike Type

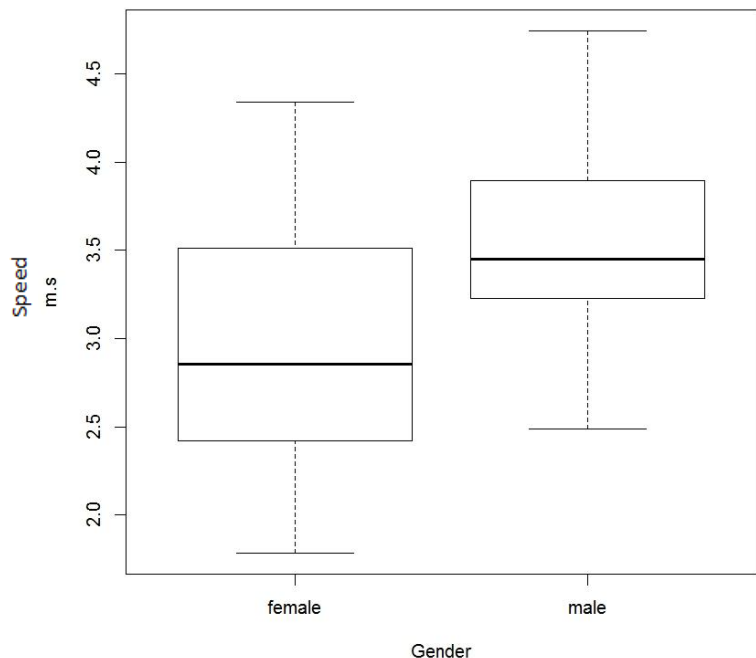
$t = 0.0236$, $df = 58$, $p\text{-value} = 0.9813$

95% Confidence Interval:
(-0.3608294, 0.3694383)

Sample estimates:

| | |
|-------------------|-------------------|
| Mean in group MFS | Mean in group RFS |
| =3.216955 m/s | =3.212650 m/s |

Speed is Associated with Gender



Two Sample t-test

Data: Speed (m.s) by Gender

$t = -3.4879$, $df = 55.221$, $p\text{-value} = 0.0009631$

95 percent confidence interval:
(-0.9026534, -0.2439244)

Sample estimates:

| | |
|----------------------|--------------------|
| Mean in group female | Mean in group male |
| =2.927871 m/s | =3.501160 m/s |

Conclusions

RFS is advantageous in performance for male mid- to long-distance runners

MFS is advantageous in performance for female mid- to long-distance runners

Less time spent in contact with the ground generally results in faster finishing times

Longer stride is correlated to faster race speed

Works Cited

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- McDougall, Christopher.. The Once and Future Way to Run. New York Times. 2014. pp. 1-35.
- Novacheck, Tom. The biomechanics of running. Elsevier Science B.V. Vol 7. pp. 77-95, 1997