

# Athletics South Africa Coaches Symposium

## Bloemfontein – 7 October, 2016

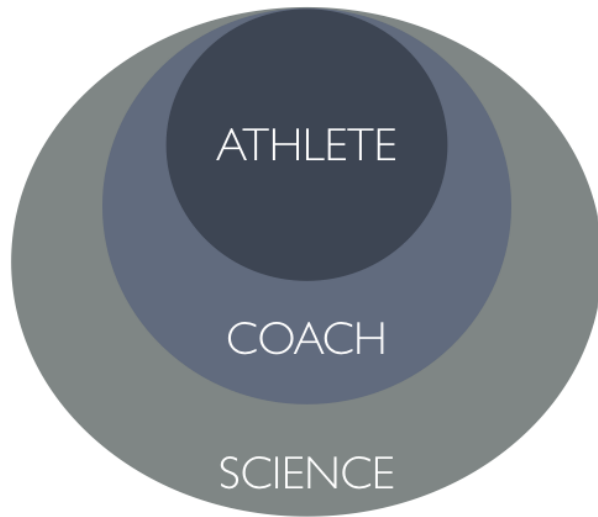
### Supporting the Coach's Eye: Measurements That Matter

Helen Bayne, PhD

Head Biomechanist

University of Pretoria, High Performance Centre





ATHLETE FOCUSED

COACH LED

SUPPORTED BY SCIENCE

# Performance Model

Health	Physiology	Technique	Nutrition
Mental state	Recovery & adaptation	Performance analysis	Strength training
Innovation	Performance lifestyle	Athlete monitoring	Supplements

**= Performance**  
(Time / Distance / Height)

... +

“Measurement is the first step that leads to control and eventually to improvement.

If you can't measure something you can't understand it.

If you can't understand it you can't control it.

If you can't control it you can't improve it.”

–H. James Harrington

“You can’t manage what you don't measure.”

–Peter Drucker

“Just because you can measure something doesn't  
mean that you should.”

–W. Edwards Deming



Decide what matters



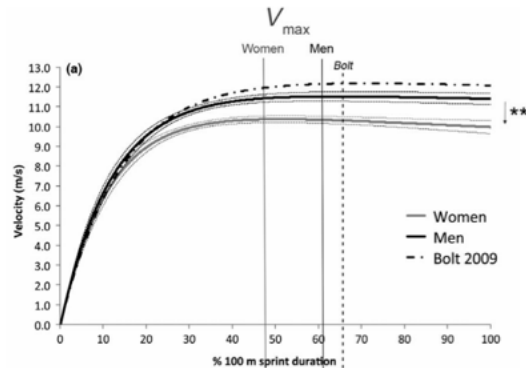
Measure it



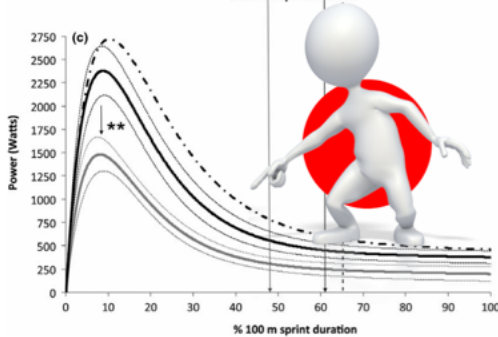
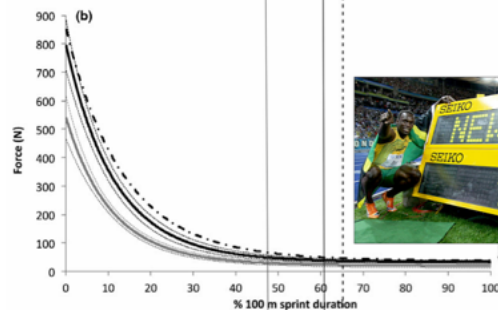
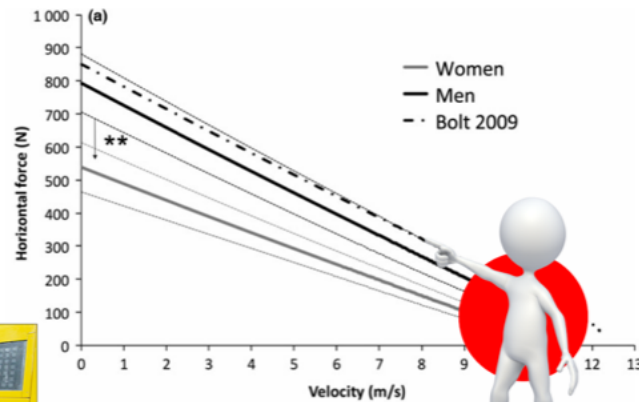
Apply

## Analysis of Usain Bolt 100-m World Record

*Designed by ©YLMsportScience*



100 distance–time curves (50 women and 50 men) were computed from international 100-m finals including Usain Bolt WR



Regarding Bolt's velocity-time relationships, his maximal velocity is reached later in the race compared to the other sprinters, which can be mainly associated to greater  $V_0$  values allowing him to keep producing horizontal force, and in turn accelerating, at speed higher than  $\sim 11.5$ – $12$  m/s, while other world-class sprinters have ever reached their  $V_{max}$

### Reference

J. Slawinski, N. Termoz, G. Rabita, G. Guilhem, S. Dorel, J.-B. Morin, P. Samozino, SJMSS, December 2015

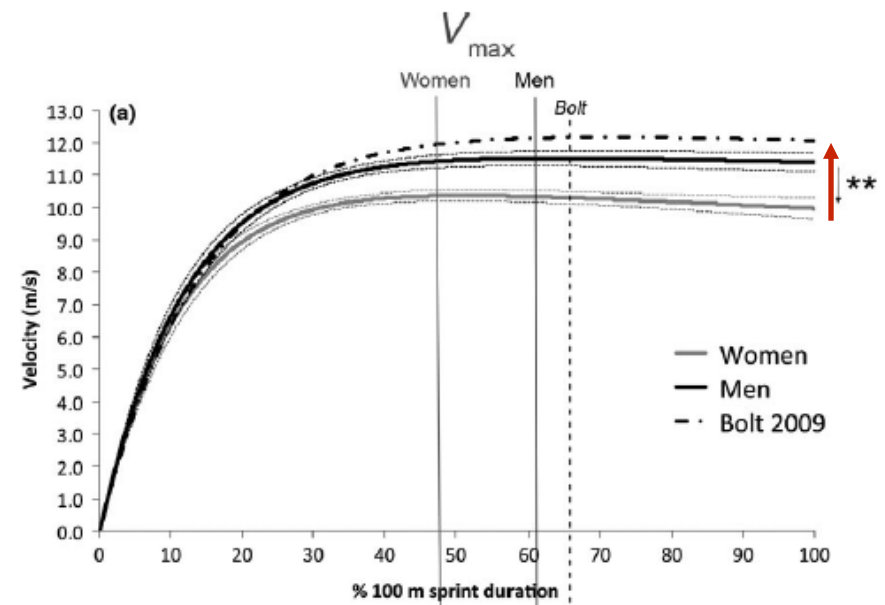
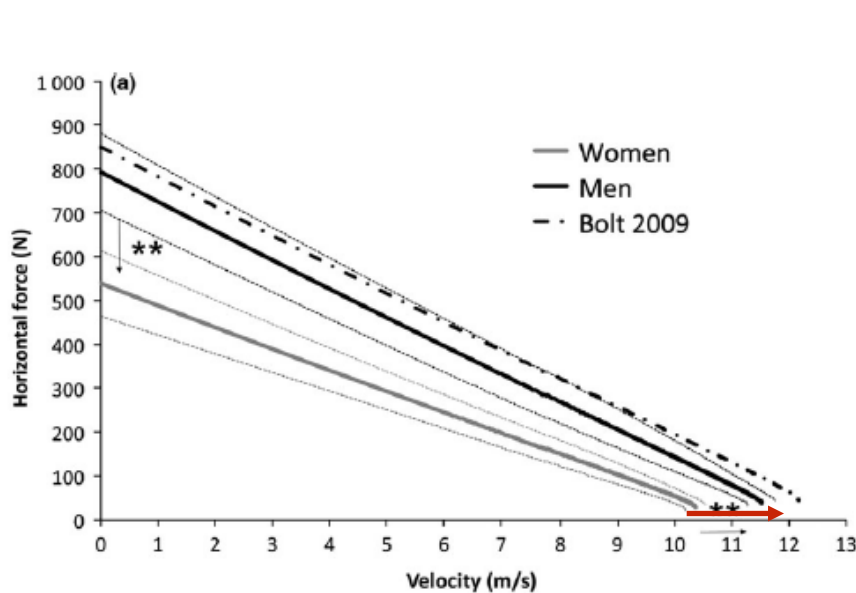




# Decide What Matters

Higher maximum velocity later in the race is a key determinant of 100m performance

Requires the ability to keep accelerating at high speeds



## PHYSICS

Newton's second law:

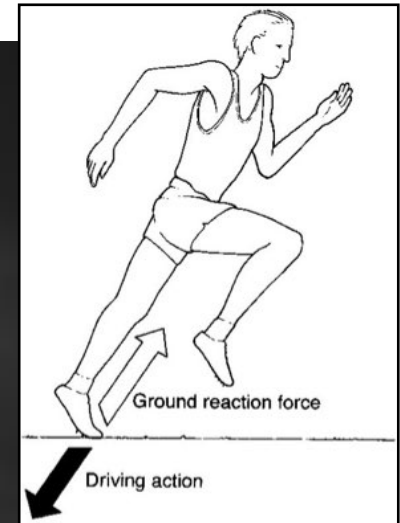
Force = mass x acceleration

$$F = m.a$$

Force is required to accelerate a body

Newton's third law:

for every action there is an equal and opposite reaction



## Technical Ability of Force Application as a Determinant Factor of Sprint Performance

JEAN-BENOÎT MORIN, PASCAL EDOUARD, and PIERRE SAMOZINO

*Université de Lyon; and Laboratory of Exercise Physiology, Saint-Etienne, FRANCE*



- 100m sprint times related to:
- Horizontal force
- Ratio of horizontal:vertical force
- NOT total amount of force produced

# Measure It

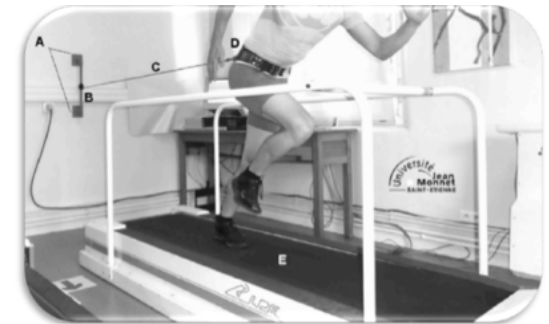
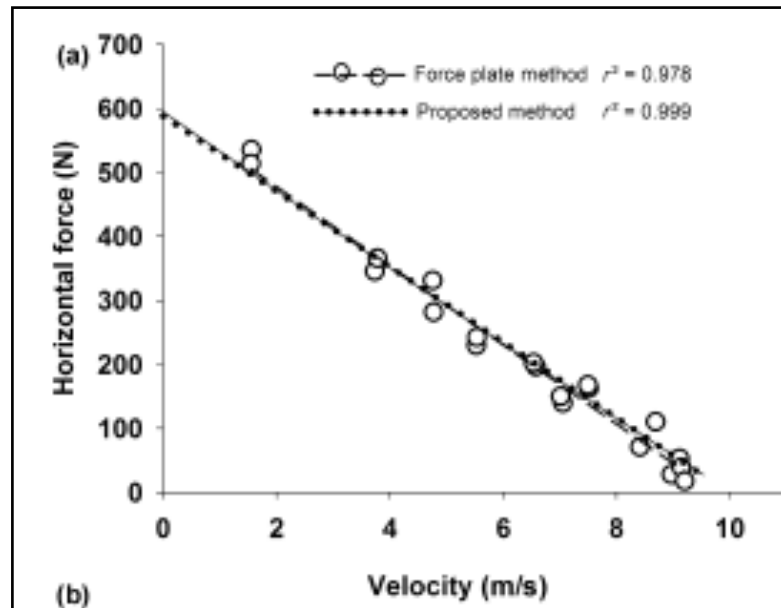
Scand J Med Sci Sports 2015; xx: xx-xx  
doi: 10.1111/sms.12490

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SCANDINAVIAN JOURNAL OF  
MEDICINE & SCIENCE  
IN SPORTS

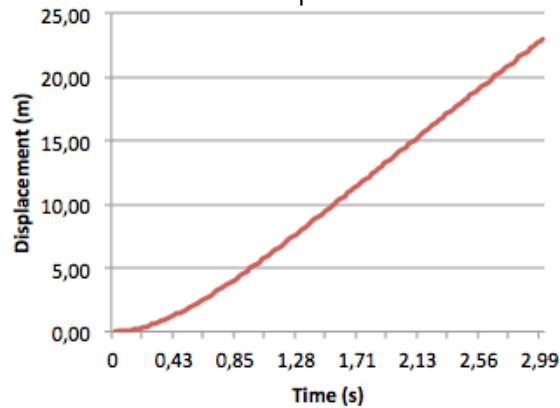
## A simple method for measuring power, force, velocity properties, and mechanical effectiveness in sprint running

P. Samozino<sup>1</sup>, G. Rabita<sup>2</sup>, S. Dorel<sup>3</sup>, J. Slawinski<sup>4</sup>, N. Peyrot<sup>5</sup>, E. Saez de Villarreal<sup>6</sup>, J.-B. Morin<sup>7</sup>

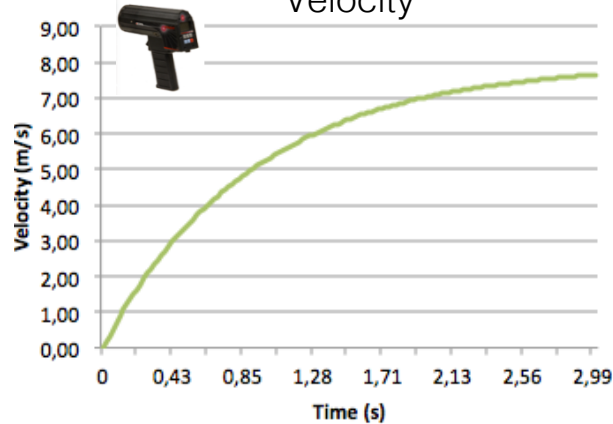


# Measure It

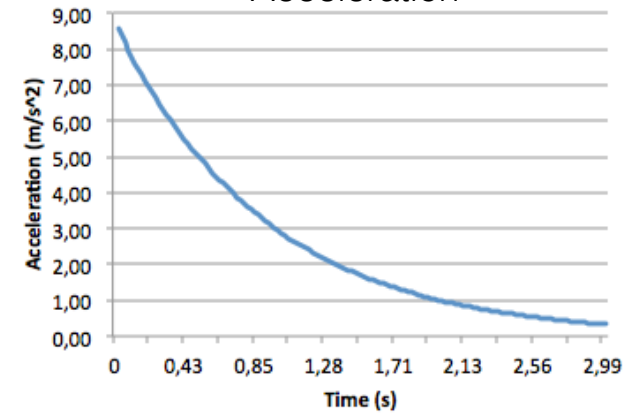
Displacement



Velocity



Acceleration

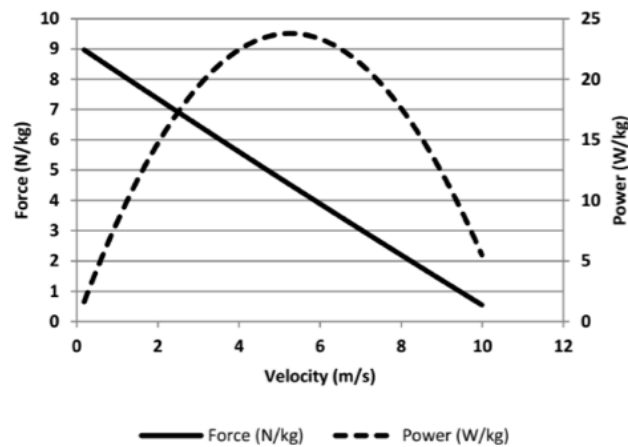


$$\text{velocity} = \text{displacement} / \text{time}$$

$$\text{acceleration} = \text{velocity} / \text{time}$$

Force-Velocity-Power

Variable	Your result	World class standard
V0 (m/s)	10.6	11.6 ± 0.2
Fh0 (N)	676.6	
Fh0 (N/kg)	9.0	10.1 ± 0.9
Pmax (W)	1783.0	
Pmax (W/kg)	23.8	30.3 ± 2.5
F-V profile (slope)	-63.7	

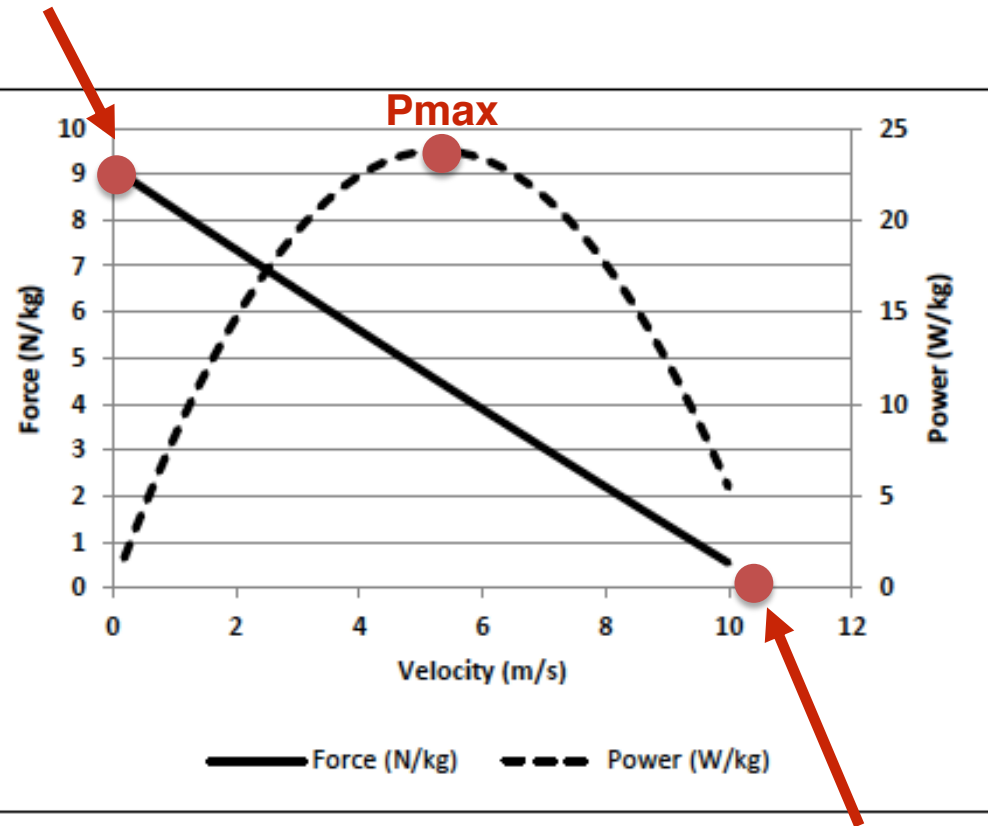


$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{power} = \text{force} \times \text{velocity}$$

# Measure It

**F0 = high horizontal force at low velocities**



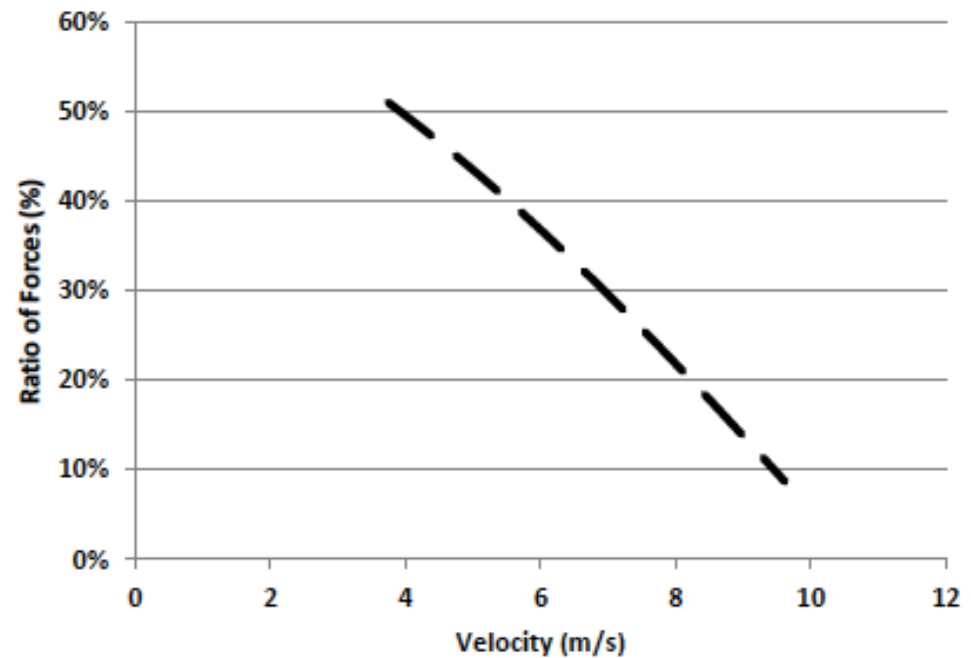
**V0 = the ability to keep producing horizontal force at high velocities**

Force-Velocity-Power		
Variable	Your result	World class * standard
V0 (m/s)	10.6	11.6 ± 0.2
Fh0 (N)	676.6	
Fh0 (N/kg)	9.0	10.1 ± 0.9
Pmax (W)	1783.0	
Pmax (W/kg)	23.8	30.3 ± 2.5
F-V profile (slope)	-63.7	

\* Slawinski (2015)

# Measure It

Ratio of force horizontal:vertical		
Variable	Your result	World class *
RFmax (%)	51%	> 50%
RF profile (slope)	-7.4%	-6.4%

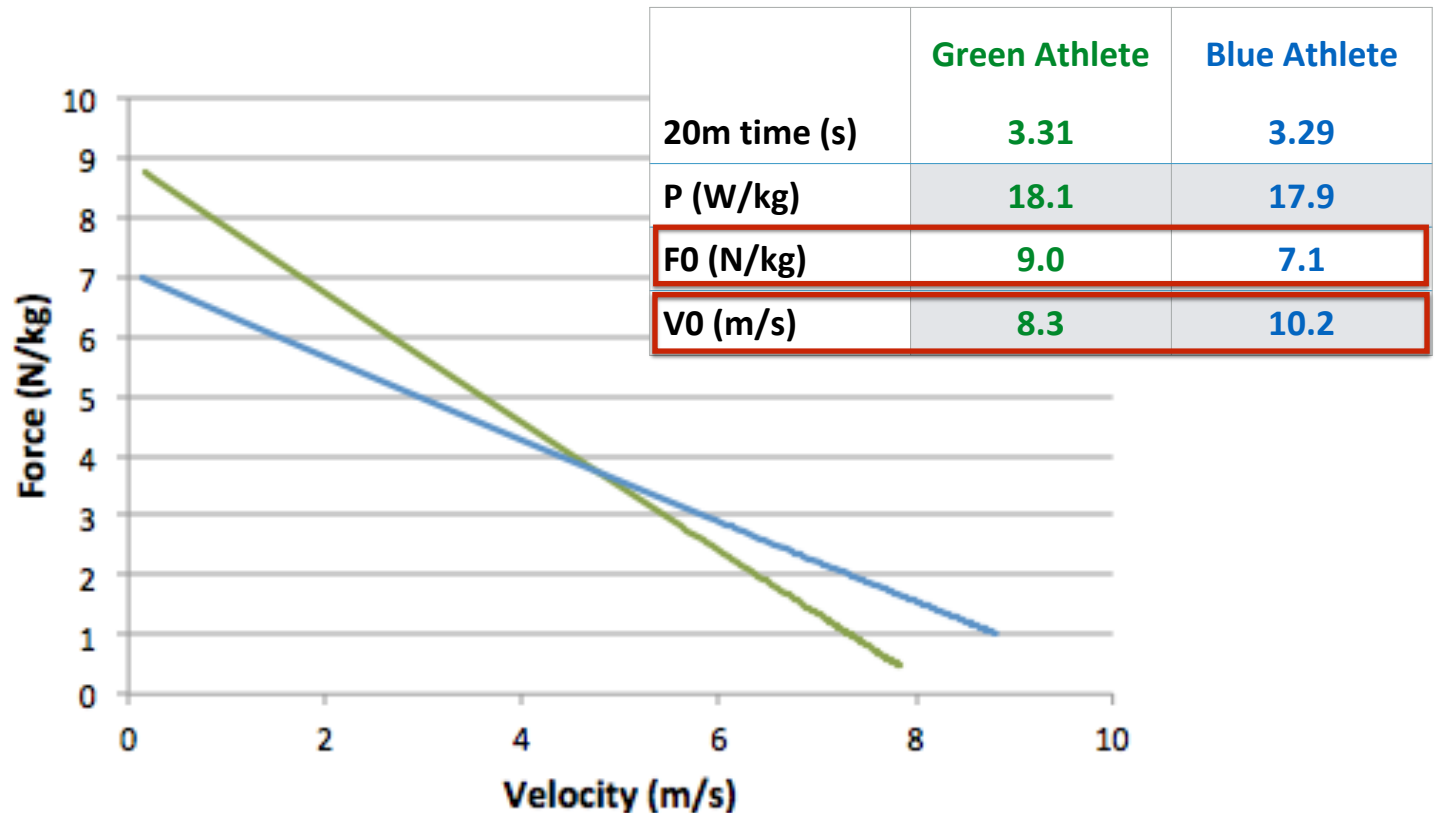


\* Rabita (2015)

## 1. Training Optimisation

Similar sprint performance - different mechanical profiles

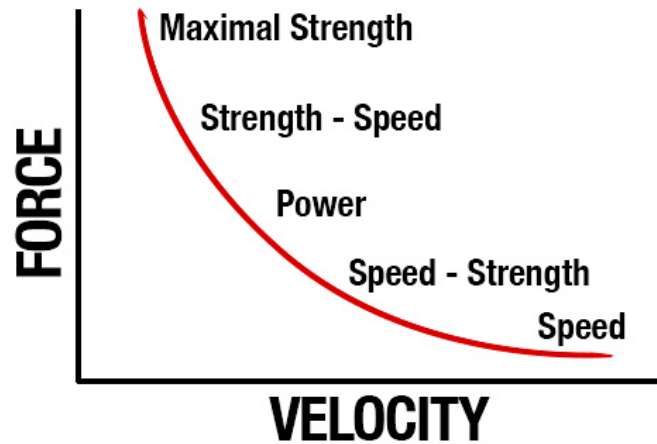
May need different types of intervention to improve sprint time





## 1. Training Optimisation

F0: resisted strength  
and sprint training

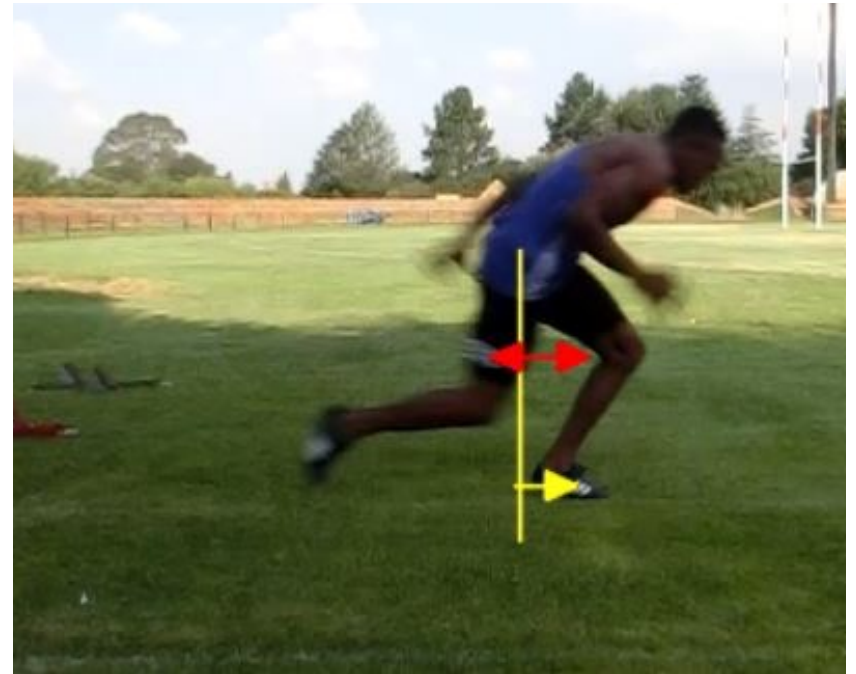


V0: BW, <BW, assisted  
sprint training



Apply

## 2. Technique Work



# Apply

**ANALYSIS VIEW** | SLIDESHOW VIEW

ANALYSIS SELECTION

Start3

COMMENTS

KEY POSITIONS

1 - 5 / 6

Set

Take off 1

Touch down 1

Take off 2

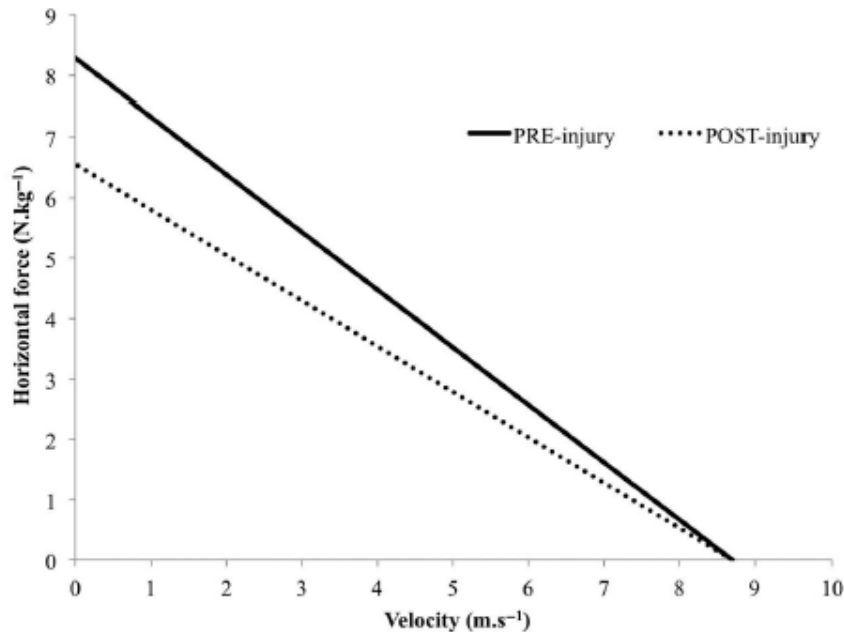
Touch down 2

This analysis was made with Dartfish software. More information on [www.dartfish.com](http://www.dartfish.com)

## 3. Injury Rehabilitation Guidelines



- Tested regularly pre-injury
- Hamstring injury
- Re-tested after medical clearance, return to full participation

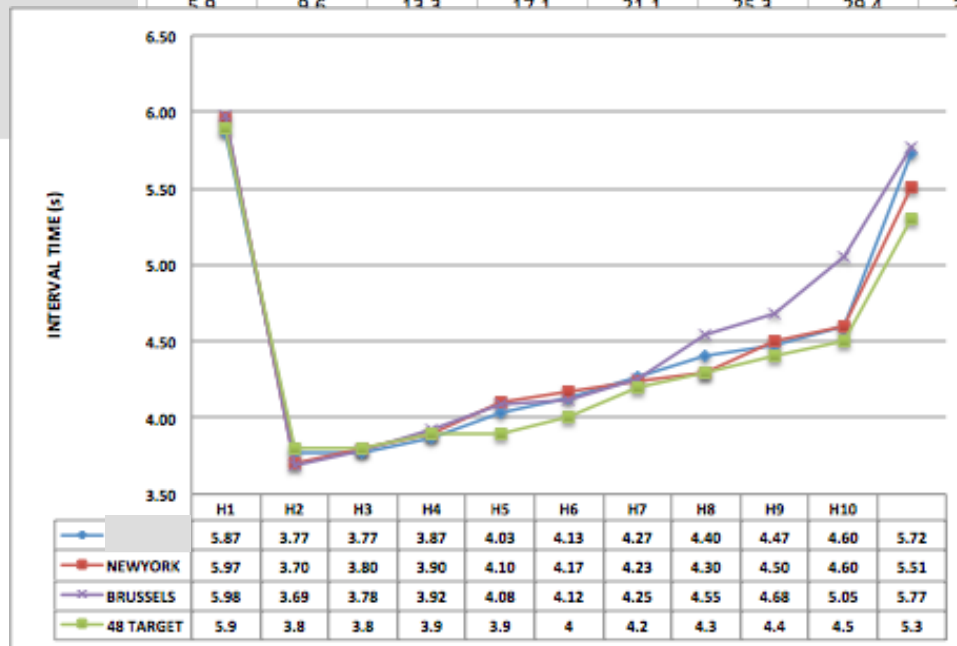


	Pre-injury	Post-injury
20m time (s)	3.33	3.56
P (W/kg)	18.0	14.2
F0 (N/kg)	8.3	6.6
V0 (m/s)	8.7	8.7

# Apply

## 4. Record Keeping

	A	B	D	E	F	G	H	I	J	K	L	M	N	O
1	Athlete Name	Year	Event Details	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	FINISH
2				5.9	9.6	13.5	17.5	21.6	25.8	30.2	34.5	38.9	43.6	48.97
3				5.9	9.6	13.4	17.3	21.3	25.4	29.7	34.1	38.6	43.2	48.89
4				6.0	9.7	13.5	17.4	21.5	25.6	29.9	34.2	38.7	43.3	48.78
5				6.0	9.7	13.4	17.4	21.4	25.6	29.8	34.4	39.0	44.1	49.86
6				5.9	9.6	13.5	17.6	21.8	26.0	30.3	34.7	39.2	43.8	49.27
7				5.8	9.4	13.3	17.3	21.4	25.6	29.9	34.4	38.9	43.7	49.52
8				5.9	9.5	13.2	17.1	21.1	25.2	29.6	34.0	38.7	43.6	49.29
15				6.1	10.0	14.1	18.2	22.4	26.6	30.9	35.4	39.9	44.6	50.09
16				6.0	9.9	13.9	18.0	22.2	26.4	30.6	34.9	39.2	43.9	49.34
24				5.9	9.6	13.5	17.6	21.7	25.9	30.3	34.6	39.1	43.6	49.13
25				5.9	9.6	13.3	17.1	21.1	25.2	29.4	33.8	38.3	43.0	48.67
31												39.3	43.9	49.46
34												39.4	44.3	49.92
36												38.7	43.5	48.92
38												38.8	43.4	48.80





Apply

## 5. Institutional Knowledge



# Measurement



Decide what matters



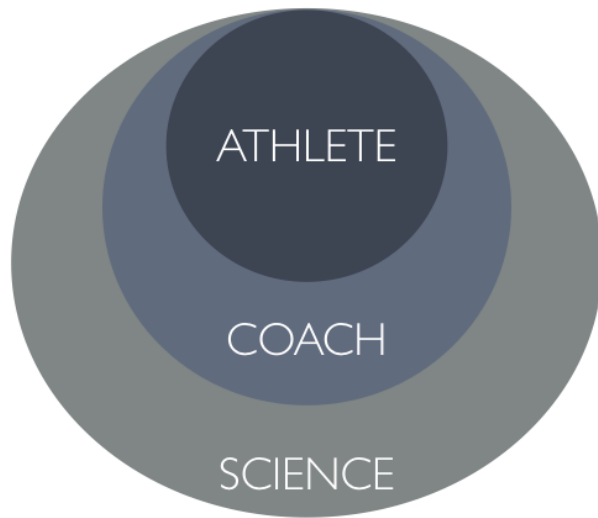
Measure it

Valid  
Reliable  
Feasible



Apply

## SUPPORTED BY SCIENCE



Athletes and coaches are experts

Observe, listen, learn,  
analyse...then suggest

Source, interpret, filter information

Contribute ideas and act as  
sounding board



Thank you for listening

Let's discuss!



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