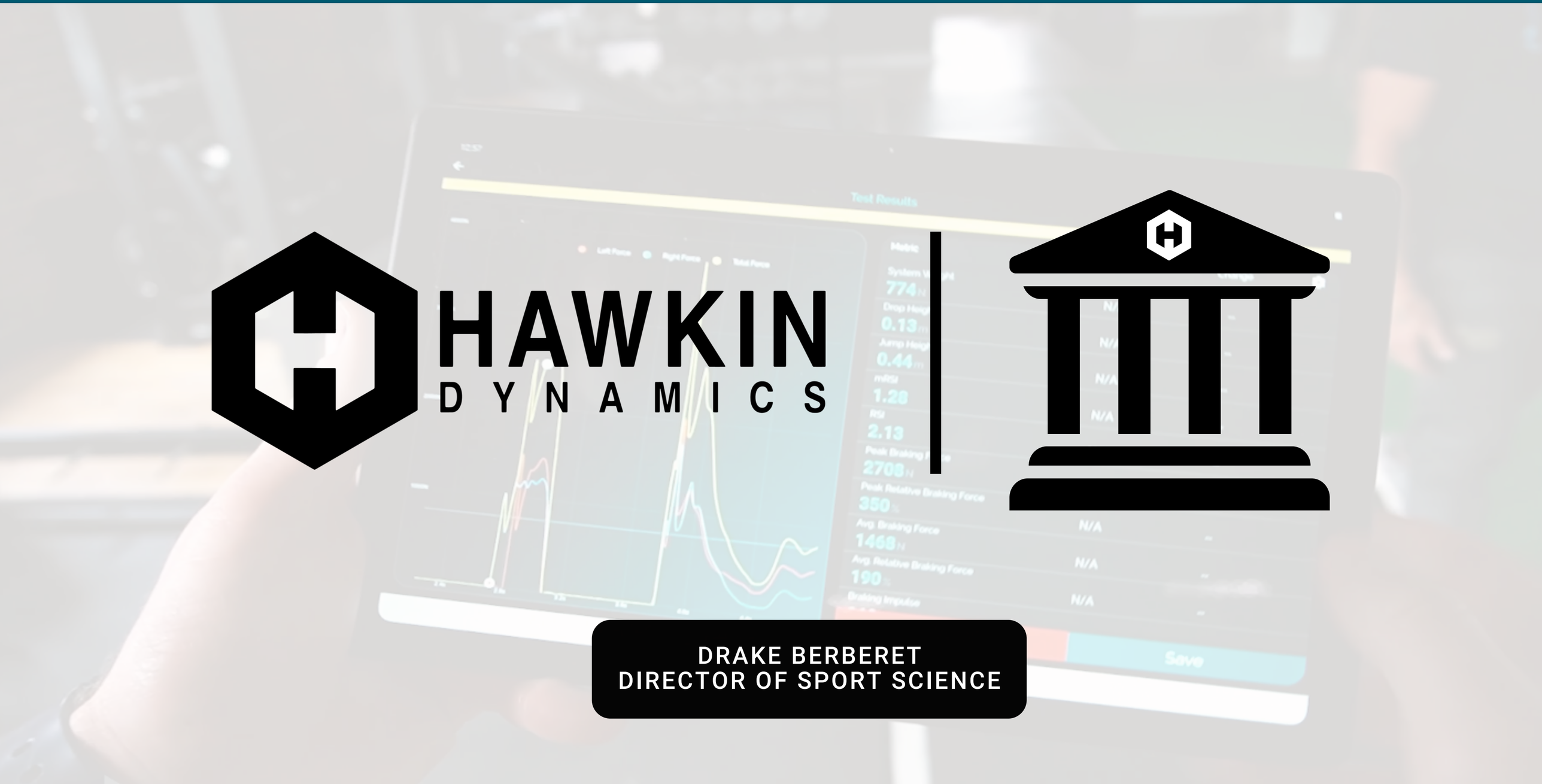
REACTIVE STRENGTH INDEX COURSE



HAWKIN DYNAMICS

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REACTIVE STRENGTH INDEX COURSE

COURSE OVERVIEW

There are links all over this course to videos and also research papers. They are highlighted in blue and underlined.

REACTIVE STRENGTH INDEX COURSE

OBJECTIVE:

We want to measure how "reactive" an athlete is...

SOLUTION:

Measure reactiveness from one, or multiple categories below. From there we can place them in "buckets" and place an emphasis on their primary need. | I.e. Force of Velocity Deficient?

This course will focus here.

1

Assess RSI
Reactive Strength Index

Traditional RSI or
Modified RSI

⋮

Assessment Options:
Drop from box & rebound
Countermovement Jump
CMJ Rebound
10 to 5 Rebound Test
Moving Hurdles
Others exist

⋮

Bilateral or
Unilateral Jumps
Linear, or Lateral

2

Assess EUR
Eccentric Utilization Ratio

CMJ:Squat Jump
(Non-Arm Swing)

CMJ:Squat Jump
(Arm Swing)

*SJ = Squat Jump

3

Assess DSI
Dynamic Strength Index

IMTP:CMJ
*the most common option and most research has been conducted here

Iso Belt Squat:CMJ
*slowly emerging as the new DSI favorite, the belt option allows an athlete to produce more lower body force because the upper body is not a limiting factor of the movement

Iso Trapbar:CMJ

Iso Back Squat:CMJ

*all CMJ can be non-arm swing or with arm swing

4

Assess FVP
Force-Velocity Profile

JB Morin's FVP

Carmelo Bosco's FVP

*use trapbar, barbell, dumbell, or other implement for the loaded jumps

5

Assess Other

Proprietary test or set of metrics

"Coaches' eye"

Force-Velocity Quadrant Chart

Others exist

REACTIVE STRENGTH INDEX COURSE

There has been a confusion of terms over the years in both research & practice.

1		2
REACTIVE STRENGTH INDEX (RSI)	VS	MODIFIED REACTIVE STRENGTH INDEX (mRSI, RSImod)
FLIGHT TIME / CONTACT TIME *ALSO* FLIGHT TIME / TIME TO TAKEOFF	VS	JUMP HEIGHT / CONTACT TIME *ALSO* JUMP HEIGHT / TIME TO TAKEOFF

KEY POINTS

Contact Time and Time To Takeoff can be used interchangeably. Time to Takeoff is the more frequently used term for a CMJ, whereas Contact Time or Ground Contact Time is typically used during a drop jump.

When performing a CMJ the term Contact Time is the same as Time To Takeoff, as the timer for both begins when the athlete is on the ground.

Both can be used for various tests/tasks.

1. Drop from a box and rebound: Drop Jump (Contact Time of <250ms, shorter box drop) or Depth Jump (Contact Time of >250ms, taller box)
2. Countermovement Jump (CMJ): Considered a slow stretch-shortening cycle tasks (Contact Time of ~500ms but varies)
3. Countermovement Jump Rebound: Perform two CMJ's back to back, maximal jump height and quickly off the ground is cued to the athlete.
4. Multi Rebound Jumps: Pogos, 10 to 5 Rebound Jump Test, Scandinavian Jump Test, etc.
5. Hurdle Jumps/Hops: Setup of these vary, but an example would be 5 hurdles setup in a straight line. Assess RSI on one of the attempts.
6. Other: You are not limited to those above for measuring RSI values. Coaches may attempt to find a more sport specific RSI.

KEY POINTS

Skill acquisition should be achieved in each movement before a coach starts to use one of these tests/tasks to profile an athlete.

For example, it might take 15 attempts for an athlete to understand how to apply force and maintain stiffness when hitting the ground after dropping from a box (i.e. drop or depth jump). 15x is a random number, but you get the idea, just like a back squat it takes time to learn proper technique.

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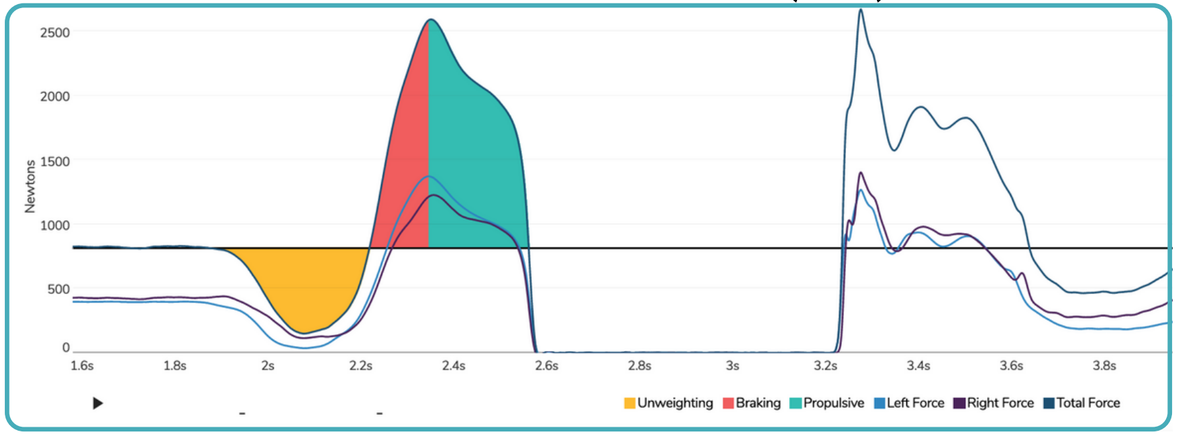
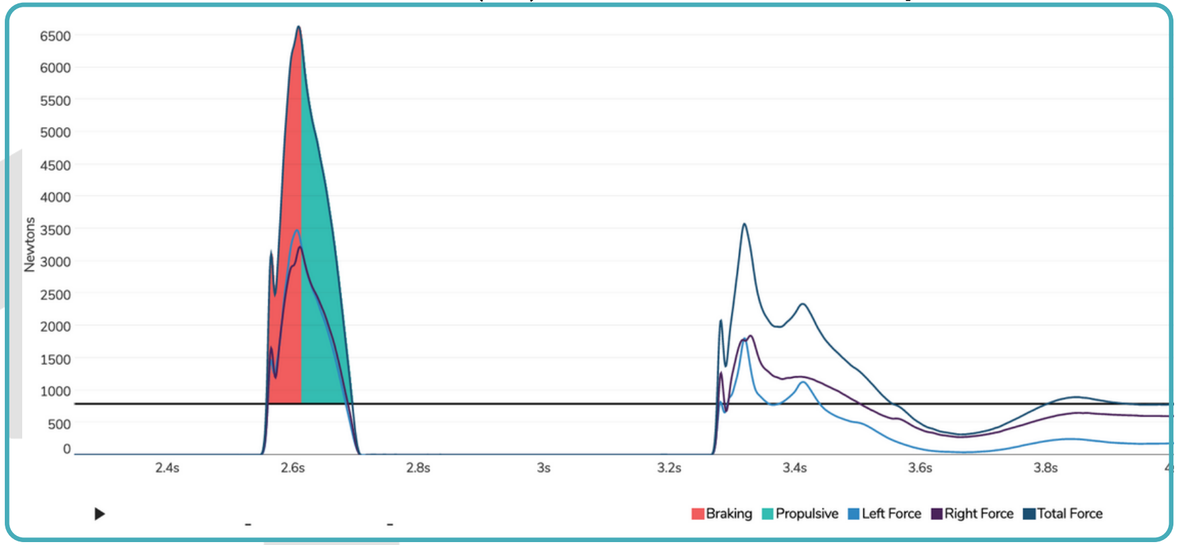
COUNTERMOVEMENT JUMP (CMJ)



SLOW STRETCH SHORTENING CYCLE MOVEMENT (>250ms)

- The Countermovement Jump (CMJ) is a common assessment of an individuals lower body ballistic strength ability. More insight here.
- The CMJ is typically used with hands on hips, the force-time curve to the left was completed this way. Video here.
- Time To Takeoff begins at the start of the yellow (unweighting phase) and ends when the athlete leaves the force plate, when force (Y-axis) is 0 Newtons.
- The athlete lands back on the force plate when force spikes around the 3.2 second mark.

DROP JUMP (DJ) - from 30cm box drop



FAST STRETCH SHORTENING CYCLE MOVEMENT (<250ms)

- The Drop Jump (DJ) is a common assessment of an individual's reactive ability. The movement is still ballistic in nature.
- In order to perform a DJ, an individual must start on top of a box, step off at the height of the box, and drop down to the ground. Upon landing, the individual is cued to immediately jump vertically as quickly and as high as possible. Video here.
- The DJ is different than the Depth Jump, whereas the Depth Jump is typically completed from a taller drop height, and moves closer in duration to a slow stretch shortening cycle movement.
- Contact Time of the DJ starts when the athlete hits the force plate (start of red braking), and ends when they leave the force plate (when force (Y-axis) is 0 Newtons.

Both images are from the Hawkin Dynamics Cloud Software

Traditional RSI is flawed...

- Flight time can be cheated rather easily. All the athlete has to do is manipulate their time in air (TIA). Flight Time and TIA are the same thing.

- TIA is what jump mats, laser timing devices, contact grids, accelerometers, a photoelectric cell, and mobile apps use to calculate Jump Height. Using the equation(s):

$$H_t = \frac{1}{8} g t_{flight}^2$$ **OR** $$CJH = (0.8747 \times AJH) - 0.0666$$

[EQ. 1 LINK] [EQ. 2 LINK]

- No disrespect to these awesome devices. They have made collecting Jump Height more accessible, but it's just not the gold standard way to calculate it. Research has shown that this method of calculating Jump Height can overestimate JH in a non-arm swing CMJ by as much as 11%.

- How do athlete's manipulate TIA? You probably see it all of the time - picking their knees up in the air, tucking at the waist, slight dorsiflexion at the ankles. Some of these are more difficult to see in real-time even if you have a keen coaches eye and have cued properly. Two videos here & here.

- Traditional RSI is much more variable compared to mRSI.

mRSI is better...but on a force plate

- Jump Height on a force plate should be calculated from Takeoff Velocity:

$$\text{Jump Height} = \frac{\text{Takeoff Velocity}^2}{2 \times \text{Gravity}}$$ [EQ. 3 LINK]

- If you are using a force plate and not using Takeoff Velocity to calculate Jump Height, then you are not using the research standard (Ask your provider why).

- Since Jump Height is calculated using Takeoff Velocity (i.e. how fast an athlete's center of mass is moving at the point of takeoff) then the value cannot be manipulated after leaving the force plates.

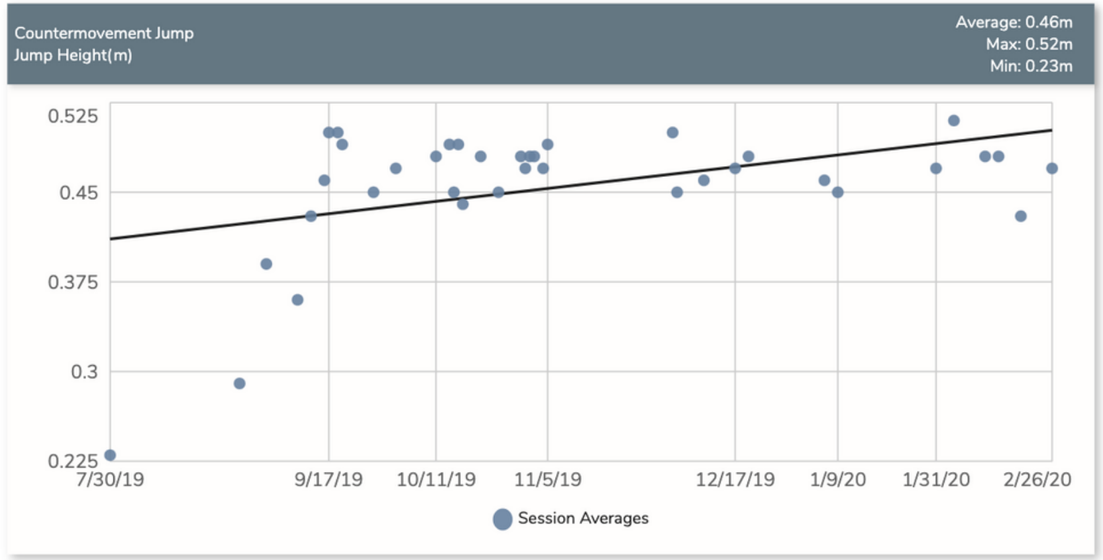
- The HD force plates will know what your Jump Height is even before the athlete lands back on the force plates.

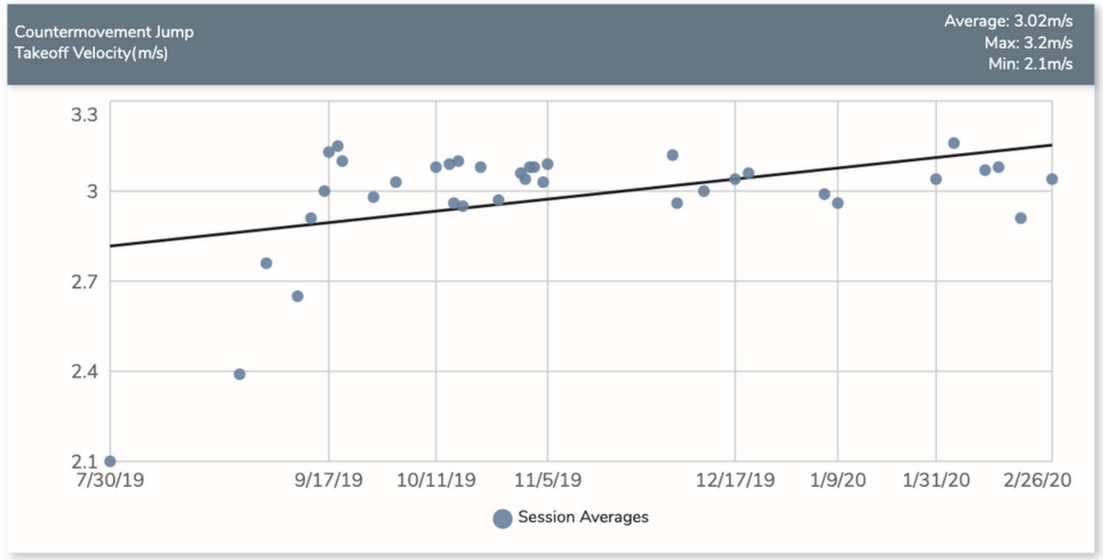
- Takeoff Velocity and Jump Height in the HD system will show almost a perfect correlation (Image on the next page).

- Some force plate softwares give you mRSI using JH / CT, however they still calculate JH using the Flight Time method. This is still not the gold standard, and the value is not as accurate.

REACTIVE STRENGTH INDEX COURSE

Comparison of Jump Height and Takeoff Velocity using the Trend Reports feature in the Hawkin Dynamics Cloud Software.





mRSI Calculation:

$$\text{Jump Height} = \frac{\text{Takeoff Velocity}^2}{2 \times \text{Gravity}}$$

$$\text{Jump Height} = \frac{3.20^2}{2 \times 9.81}$$

Jump Height = 0.522 m

$$\text{mRSI} = \frac{\text{Jump Height}}{\text{Time To Takeoff}}$$

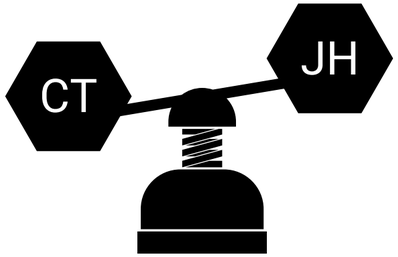
$$\text{mRSI} = \frac{0.522\ \text{m}}{0.71\ \text{s}}$$

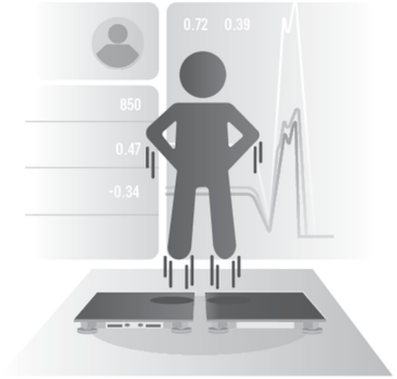
mRSI = 0.735

REACTIVE STRENGTH INDEX COURSE

The case of two mRSI values.
(Same Outputs, Different Inputs)

$$mRSI = \frac{\text{JUMP HEIGHT}}{\text{CONTACT TIME}}$$





A $0.806 = \frac{0.50\ (m)}{0.62\ (s)}$

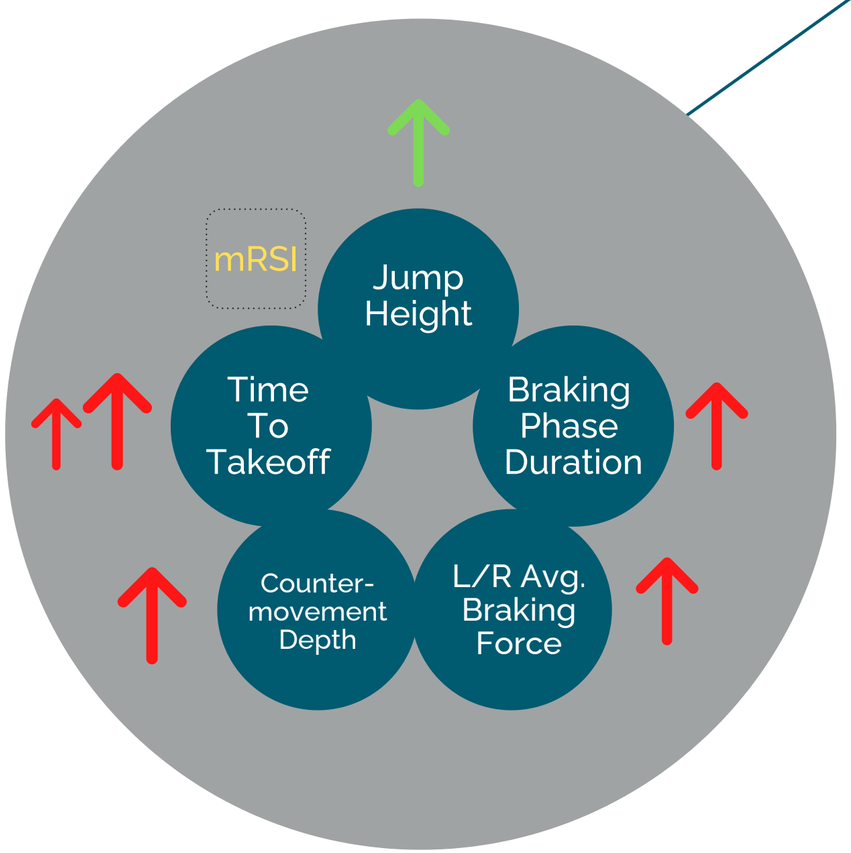
Same Outcomes | **Different Inputs**

B $0.807 = \frac{0.42\ (m)}{0.52\ (s)}$

	Comparing Between 2 Athletes	**Comparing 2 Time Points Using the Same Athlete**
Looking at mRSI only	• Both athletes are equally reactive. • mRSI values are both ~0.80	• The athlete has maintained his mRSI value of 0.80 • Are training is solid, we are maintaining reactiveness in-season
Looking at mRSI, and its parts	• Actually when we dive deeper, they achieved the same value differently • Athlete A jumps higher than Athlete B, but Athlete B is quicker • Which one is better? • Taking this with context to the sport and position we can decide which is an optimal profile.	• Actually, the athlete is not jumping as high • But he is jumping quicker • Is he providing intent? • Have we neglected strength work and placed too much emphasis on speed work? • What part of the annual plan are we in?

If context is king, then we must actually give ourselves a chance to understand context.

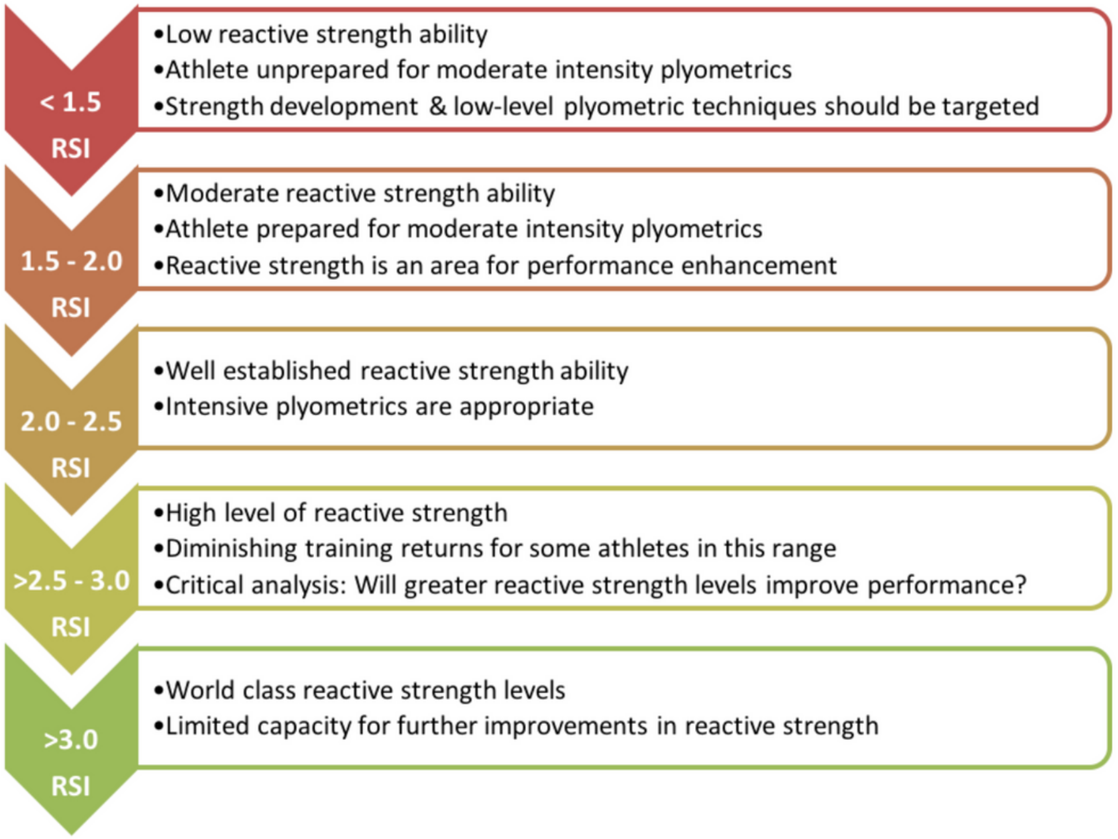
- When we look at metrics in isolation (I.e. mRSI), we limit our understanding of what is actually taking place.
- We should instead look at multiple metrics together and their interactions - "Metric Bubbles"
- This allows us to paint a clearer picture of what is actually taking place.
- Looking at 1 metric alone (i.e. "the best metric") is comparable to waking up in the morning, looking out the window and seeing the sun shining. Throwing your shorts on and a tank top, running out the door to enjoy the beautiful weather, only to realize its the middle of January and the temperature is -12 degrees.
- Gathering multiple metrics helps us gain a better understanding of what is actually occuring.



An example of a Metric Bubble

- Jump Height is up, without context the athlete is good. He is jumping higher. Full steam ahead, lets max out today.
- But wait, when we look deeper we see that the time of the jump is much longer. I wonder why, let's look deeper.
- He is spending more time during the braking phase, and also sinking in deeper to produce the jump. He could be fatigued.
- (Additional Sport Context Added) Actually, you know what...this makes sense because coach has been running the team like dogs at practice.
- His Asymmetry is also higher than normal, I wonder if he has a nagging soft tissue flare up.
- Solution: Let's lower volume today, make soft tissue work a priority during the prelift, and chat with our athletic trainer to make sure he gets seen later in the day.

What is a good value?



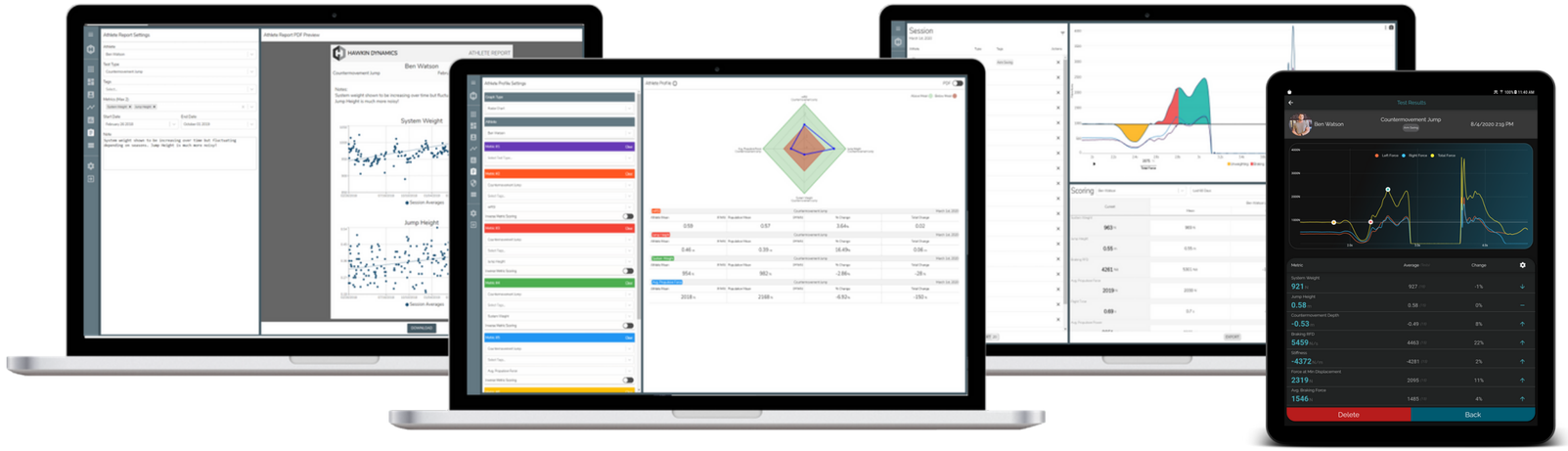
This figure and values are pulled from the Push series on RSI by Dr. Eamonn Flanagan
Dr. Flanagon uses the term RSI but states in his article that he uses JH / CT (mRSI).

- Use this figure for mRSI (JH/CT) when assessing a drop jump. We typically suggest starting with a 30cm drop height.
- If you are using a CMJ to assess mRSI values and this figure, then your output value won't match these values. The range of mRSI values during CMJ's is between 0.2-0.85.
- For CMJ mRSI, Dr. Matt Jordan uses a multiplication factor of 3, and we like this multiplier also. For example, if an athlete obtains an mRSI value of 0.50 on a CMJ - multiply that by 3 and the athlete has a score of 1.5. That athlete would fall into the moderately reactive category.
- A practitioner should understand that these values should be taken with a grain of salt, and the best approach is to determine your own thresholds and categories within your specific population of athletes (i.e. sport, age, & gender).
- For reference, Dr. John McMahon has a solid paper on Rugby mRSI norms that can be found here.

I'm ready to start using mRSI in my setting, where do I begin?

- Select the assessment you want to use to measure mRSI
  - We have drop jump, CMJ rebound, multi rebound, and free run built into our system
  - We suggest starting with a drop jump dropping from a 30cm box height
- Standardize the procedure as much as you can - i.e. similar warmups before each testing day
- Test as frequently as possible.
- Once you feel good about your procedure and number of attempts collected on each athlete (i.e. skill acquisition), start analyzing the data.

- Our system makes it easy to compare values over time and in real-time.
- Automatically generated reports in the cloud app and instant percent change of metrics in real-time on the tablet (shown below).
- Our dedicated team of sport scientist are also available to help.



MORE RESOURCES BY HAWKIN DYNAMICS

FREE

The HD Blog - a resource for users of all force plates, not just our own.

We take a no BS approach to force plate application. Checkout our free blog and educational content provided by industry experts.

FREE

We also have a lot of free content on our YouTube page.

Whether you just want to see how our system works in real-time, or learn about force plate metrics & application we have both, and its all free.

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