Athletic Profiling:
Testing Models That Transfer to Sport

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Objectives…

- Athletic Profiling
  - Discuss the need for athletic profiling and the factors that underpin sports performance
  - Define the strength qualities that underpin performance
  - Present an athletic profiling model through the use of jumping, sprint, and agility performance measures
  - Discuss the relationship of performance measures and their correlation to various strength qualities

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Athletic Profiling

Defining the Factors that Underpin Sports Performance

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Athletic Profiling Defined…

- Field tests that capture an athlete's performance capabilities in terms of sport specific needs
- Field tests represent distinct motor abilities with common strength quality needs

Completion of field tests create an athletic profile that drives prioritization of training process

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Purpose of Athletic Profiling...

- Identify performance deficits to prioritize training process
- Monitor training adaptation and readiness
- Talent Identification
- Discriminate between playing ability
  - High vs. Low Performance

(Vescovi, J. and McGuigan, M., 2008)

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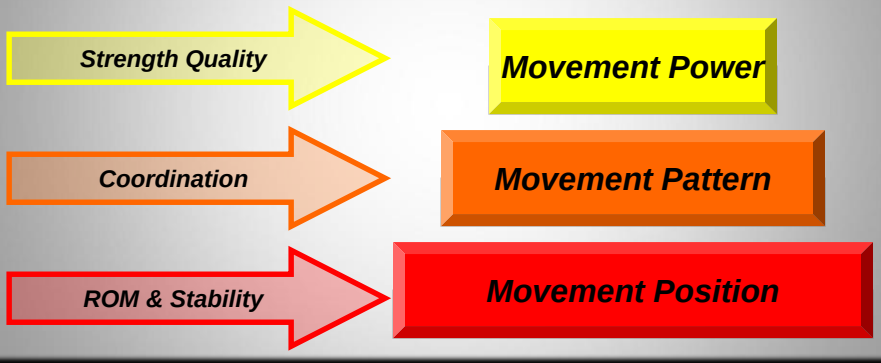
Athletic Profile Hierarchy

To optimize athletic potential we must first identify the relevant limiting factors within each movement



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Factors Underpinning Sport…

- Profiling Considerations:
  - Linear Sprint Speed
  - Multidirectional Speed
    - Change of Direction
    - Reactive Agility (Decision Making)
  - Vertical-Horizontal Jumping Profile
  - Strength Quality Needs

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Strength Qualities

The Engine of Sports Performance

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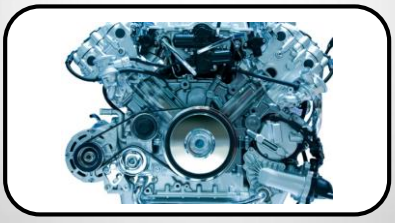
Strength Qualities Defined…

The capability of the neuromuscular system to express various force-velocity relationships in relation to time and load



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Strength Qualities Defined…

- Maximal Strength (Relative)
  - Peak force the neuromuscular system is capable of producing during a single repetition irrespective of time (per kilogram)
- Speed-Strength (Maximal Power Emphasis)
  - Highest rate of force development the neuromuscular system is capable of producing at a given load
    - Starting Strength
    - Explosive Strength
    - Reactive Strength

(Poliquin, C., 1989)

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Strength Qualities Defined…

- Starting Strength
  - Maximal rise in force the neuromuscular system is capable of producing during the start of a movement (40-50ms)
- Explosive Strength
  - Ability of neuromuscular system to generate maximal rise in force once movement has started (100+ms)
- Reactive Strength
  - The ability of the neuromuscular system to maximize the use of the stretch shortening cycle during short ground contacts (<250ms) and often under high ground reaction forces (e.g. x4-6 body weight)

(Poliquin, C., 1989)

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Strength Quality Testing…

- Direct
  - Maximal (Relative) strength can be directly tested through traditional strength methods (e.g. 1RM Testing)
- Problem
  - Athlete age, experience, and available training time does not always warrant direct strength testing, but there is still a need for a strength profile to drive the training process

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Strength Quality Testing…

- **SOLUTION:**

  Athletic profiling uses a combination of field tests with common strength characteristics to provide insights on strength quality needs in terms of movement performance

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Athletic Profiling Model

Sprinting…Jumping…Agility

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Sprint Profiling…

- Linear movement is fundamental to sport with the distance run dictating the strength and movement needs
- Brown et al. recommends that various sprinting splits be captured to create a sprinting profile
- Research has shown that different sprint zones are involve distinct motor ability with different strength needs

(Brown et al., 2004 and Little and Williams, 2005)

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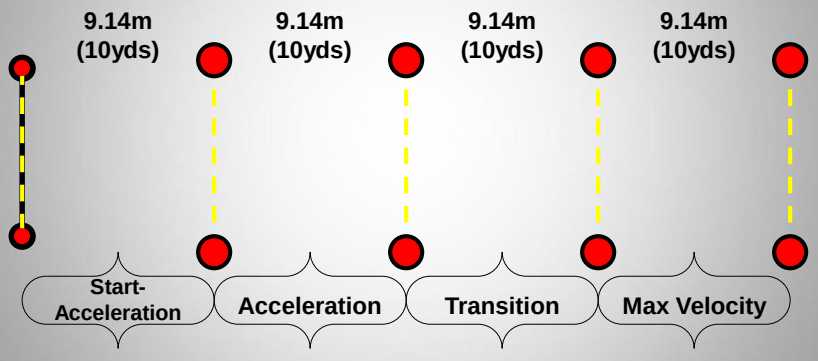
40yd Sprint: Laser Start at Hand



(Brown et al., 2004)

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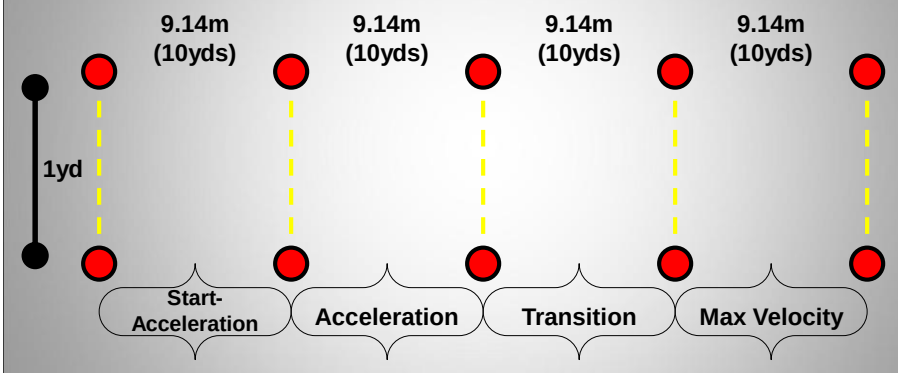
40yd Sprint: Flying Laser Start



(Brown et al., 2004)

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Jumping Profile…

- Vertical and horizontal jumping is fundamental to sport and it has been shown that different jump types relate to different strength quality needs (Young et al. 1999)
- Different jump profiles relate to different sprint profiles as there is common SSC characteristics via GCT and GRF (Hennessey and Kilty, 2001)

(McGuigan et al., 2006 and Winkelman, 2010)

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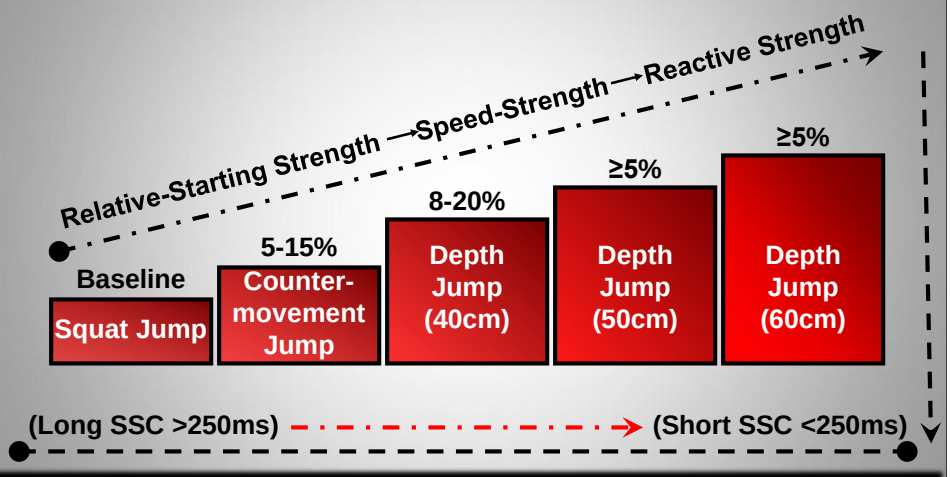
Jump Profiling: SJ, CMJ, DJ



(Schmidtbleicher, 1994 Winkelman, N. 2010)

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Agility Profile…

- The ability to change direction and react is fundamental to all sport and therefore we must be able to test both capabilities
- Change of Direction:
  - A pre-programmed rapid whole-body movement with change in velocity and direction of movement
- Reactive Agility
  - A rapid whole-body movement with change of velocity and direction in response to a stimulus

(Sheppard and Young, 2006/2011)

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An evaluation of a new test of reactive agility and its relationship to sprint speed and change of direction speed

Journal of Science and Medicine in Sport (2006) 9, 342–349

J.M. Sheppard[a,b,c,*], W.B. Young[b], T.L.A. Doyle[c], T.A. Sheppard[b,c], R.U. Newton[c]

- **Subjects:**
  - High Performance Group (HPG): 23m Senior WAFL
  - Lower Performance Group (LPG): 14m Reserve WAFL
- **Methods:** A test of reactive agility was compared to a similar change of direction test that did not involve anticipation or decision making
  - Change of Direction Speed Test (CODST)
  - Reactive Agility Test (RAT)
    - 4-6 repetitions in each direction in randomized order (8-12 total)
    - Mean time in each direction is recorded for comparison

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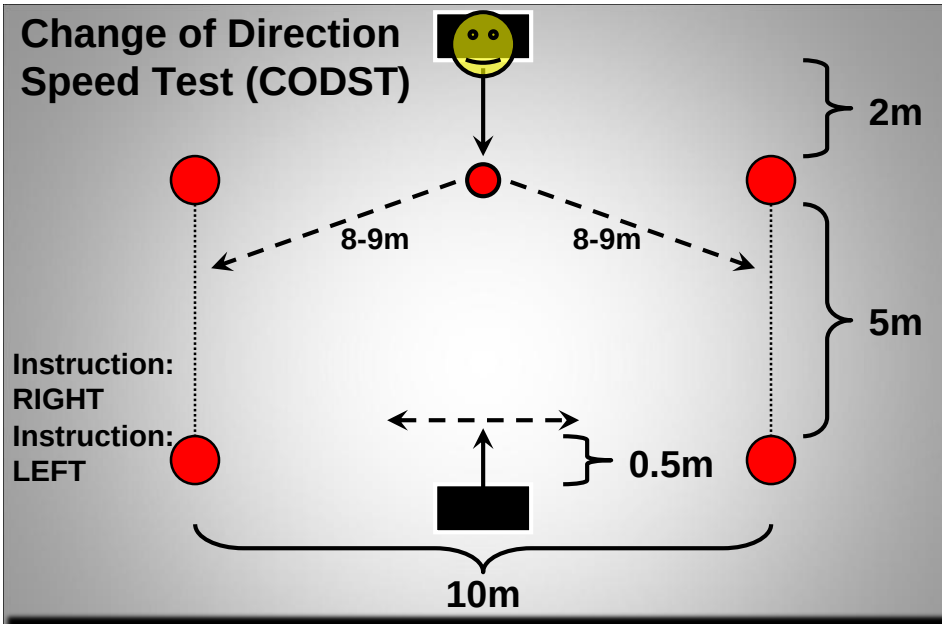
Change of Direction Speed Test (CODST)



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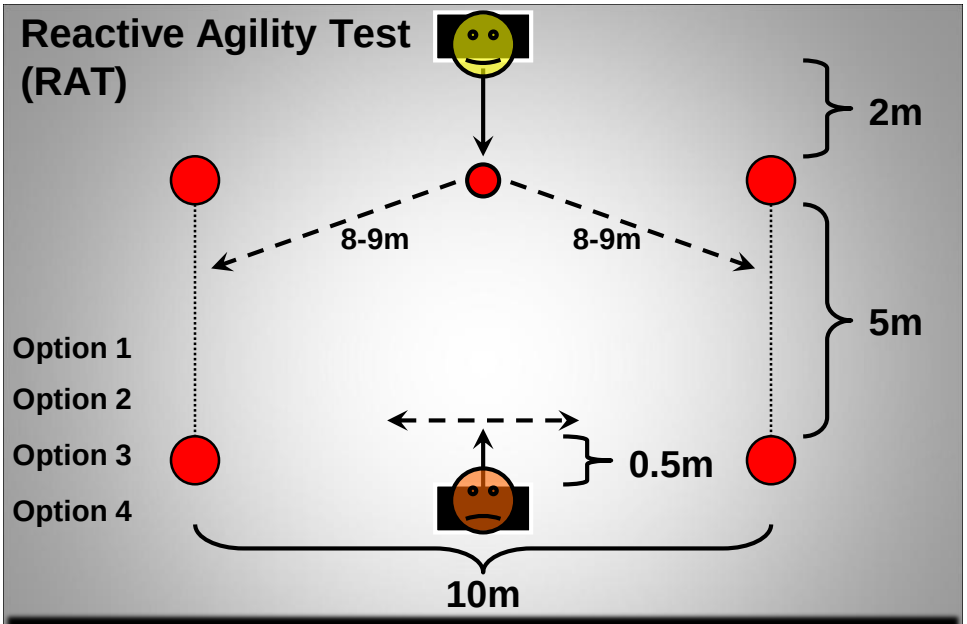
Reactive Agility Test (RAT)



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Results:

Table 2 Mean difference between lower performance group and higher performance group on the speed variables

Variable	Lower performance group (*n*: 15)	High performance group (*n*: 23)
10 m straight sprint (s)	1.895	1.909 (0.7% slower)
Standard deviation	±0.053	±0.067
Effect size statistic		0.23
Change of direction speed (s)	1.609	1.640 (1.9% slower)
Standard deviation	±0.092	±0.086
Effect size statistic		0.35
Reactive agility test (s)	1.639	1.553 (5.2% faster)*
Standard deviation	±0.082	±0.070
Effect size statistic		1.13

* Statistical significance ($p = <0.05$).

Table 3 Correlations between the speed, change of direction, and agility variables

	Change of direction speed test	Reactive agility test
Straight sprint test	0.738** (54%)	0.333* (11%)
Change of direction speed test		0.321* (10%)

Percent common variance is shown in brackets for selected comparisons.
* Significant at the 0.05 level.
** Significant at the 0.01 level.

The HPG was significantly better (p= 0.001) than the LPG on the RAT with no difference seen on the CODST and 10m sprint

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Athletic Profiling Research

Sprinting…Jumping…Agility

Strength Qualities?

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What measures are most important?

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Journal of Strength and Conditioning Research, 2005, 19(1), 76–78
© 2005 National Strength & Conditioning Association

Specificity of Acceleration, Maximum Speed, and Agility in Professional Soccer Players

Thomas Little[1] and Alun G. Williams[2]

[1]Sport, Health and Exercise, Staffordshire University, Stoke-on-Trent, Staffordshire, United Kingdom; [2]Institute for Biophysical and Clinical Research Into Human Movement, Manchester Metropolitan University, Alsager, United Kingdom.

- **Subjects:** 106m professional soccer players
- **Methods:** 10m sprint, flying 20m sprint, zigzag agility test
- **Results/Conclusion:**
  - Acceleration and Maximal Speed shared a common variance 38%, Acceleration and Agility 12%, and Maximal Speed and Agility 21%
  - This provides evidence that each of these are different motor abilities with distinct strength needs

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The role of strength qualities…

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Relationship between strength qualities and sprinting performance

J SPORTS MED PHYS FITNESS 1995;35:13-9

WARREN YOUNG, BRIAN McLEAN, JAMES ARDAGNA

- **Subjects:** 20(11m/9f) Australian Junior T&F Squad
- **Sprint Testing:** Blocks-50m (2.5, 5, 10, 20, 30, 40, 50m)
- **Strength Testing:**
  - SJ 90º- *Speed-Str* with large knee angle
  - SJ 120º/wt- Relative *Speed-Str* with small knee angle
  - CMJ- *Speed-Str* SSC (long GCT >250ms)
  - DJ (30, 45, 60, 75cm)
    - DJ (ht/wt)- *Reactive-Str* SSC (short GCT <250ms)
  - Iso 120º (Abs/Rel)- *Maximal-Str* under 15s isometric condition

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- **Results:**
  - <2.5m t: ↑ correlation to SJ 120º Fmax/wt
    - ↑ **Start-Str Contribution and Relative-Str Contribution**
  - >10m t: ↑ correlation to SJ 120º F100ms/wt, CMJ, and IsoFmax,
    - ↑ **Explosive-Str and Relative/Max-Str Contribution**
- **Conclusion:**
  - Strength Quality – Sprint Phase Relationship
    - Time to develop force (GCT)
    - Joint angles (e.g. 126º back knee in start)
  - Relative Strength ≤ 10yd ≤ Maximal Strength

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Relationship between strength qualities and performance in standing and run-up vertical jumps

J SPORTS MED PHYS FITNESS 1999;39:285-93

W. YOUNG, G. WILSON*, C. BYRNE

- **Subjects:** 29(m) with >1yr jumping/sprinting experience
- **Jump Testing:** CMJ and Run-Up Jump (1-leg takeoff)
- **Strength Testing:**
  - SJ 90º- *Speed-Str* with large knee angle
  - SJ 120º/wt- Relative *Speed-Str* with small knee angle
  - DJ (30, 45, 60, 75cm)
    - DJ (ht)- *Speed-Str* SSC (long GCT >250ms)
    - DJ (ht/t)- *Reactive-Str* SSC (short GCT <250ms)
  - Iso 120º (Fmax/wt)- *Maximal-Str* under 10s isometric condition

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- **Results/Conclusion:**
  - All speed and reactive strength variables correlated significantly with all jump types
  - DJ (ht): ↑ correlation to CMJ, GCT (>250ms), and (90ºknee)
    - ↑ **Explosive-Str Contribution**
  - DJ (ht/t): ↑ correlation to run-up, GCT (<250ms) and (120ºknee)
    - ↑ **Reactive-Str Contribution**

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ORIGINAL ARTICLE

Strong correlation of maximal squat strength with sprint performance and vertical jump height in elite soccer players

U Wisløff, C Castagna, J Helgerud, R Jones, J Hoff

Br J Sports Med 2004;**38**:285–288. doi: 10.1136/bjsm.2002.002071

- **Subjects:** 17m professional soccer players
- **Methods:** CMJ, 1RM Half Squat 90º, and 30m Sprint
- **Results/Conclusion:**
  - Maximal Strength had a high correlation to 10m (r=0.94) and 30m (r=0.71) sprint times
  - Maximal Strength had a high correlation to CMJ height (r=0.78)
  - The CMJ had a high correlation to 10m (r=0.72) and 30m (r=0.60) sprint times

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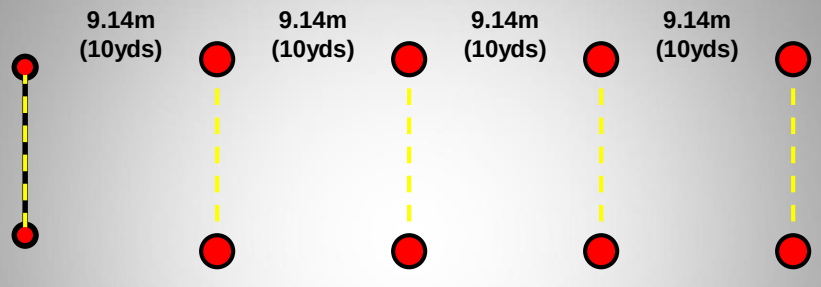
Sprinting…Conclusion



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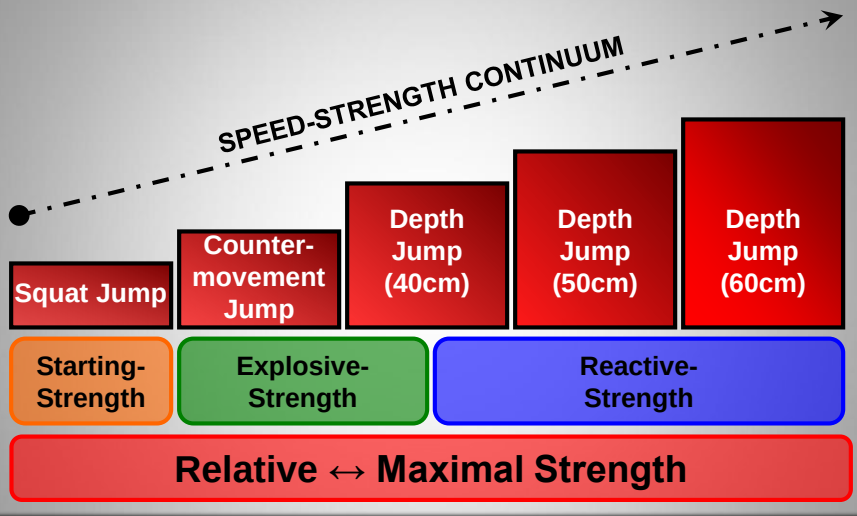
Vertical Jumping…Conclusion



(Schmidtbleicher, 1994 Winkelman, N. 2010)

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Relationships between sprinting, jumping, and agility…

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SJ/CMJ vs. Sprinting

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Journal of Strength and Conditioning Research, 2005, 19(2), 349–357
© 2005 National Strength & Conditioning Association

Strength and Power Predictors of Sports Speed

John B. Cronin[1] and Keir T. Hansen[2]

[1]New Zealand Institute of Sport and Recreation Research, Auckland University of Technology, Private Bag 92006, Auckland, New Zealand; [2]New Zealand Warriors Rugby League Club, Penrose, Auckland, New Zealand.

- **Subjects:** 26m Part/Full-Time Professional Rugby Players
- **Methods:** Various vertical jumps and 3RM strength was correlated with 5m, 10m, and 30m sprint times
- **Results/Conclusion:**
  - SJ/CMJ height had a strong correlation to all sprint distances (5m r= -0.64*, 10m r= -0.66*, 30m r= -0.56*)

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The Relationship Between Running Speed and Measures of Vertical Jump in Professional Basketball Players: A Field-Test Approach

Shaher A.I. Shalfawi,[1] Ammar Sabbah,[2] Ghazi Kailani,[3] Espen Tønnessen,[4] and Eystein Enoksen[5]

VOLUME 25 | NUMBER 11 | NOVEMBER 2011 |

[1]Department of Physical Performance (SPU), Centre for Practical Knowledge, University of Nordland, Bodø, Norway; [2]Department of R & D and Education, DNA Personal Training Studios, Amman, Jordan; [3]Department of Physical Education and Sport Sciences, Hashemte University, Al Zarka, Jordan; [4]Department of Physical Training, Norwegian Olympic Sport Center, Oslo, Norway; and [5]Department of Physical Performance, The Norwegian School of Sport Sciences, Oslo, Norway

- **Subjects:** 33m Professional Basketball Players (≥2yrs playing)
- **Methods:** Various vertical jumps were correlated with 10m, 20m, and 40m sprint times in absolute/relative terms
- **Results/Conclusion:** CMJ/SJ Heights correlated significantly with all sprint distances in absolute (10m r= 0.53*, 20m r= 0.57*, 40m r= 0.74*) and relative terms (10m r= 0.48*, 20m r= 0.52*, 40m 0.74*)

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DJ vs. Sprinting

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Relationships Among Jumping Performances and Sprint Parameters During Maximum Speed Phase in Sprinters

VOLUME 0 | NUMBER 0 | MONTH 2009 |

Mehmet Kale,[1] Alper Aşçi,[2] Coşkun Bayrak,[1] and Caner Açikada[2]

[1]School of Physical Education and Sports, Anadolu University, IK, Eylül Campus, Eskişchir, Turkey; and
[2]School of Sport Sciences and Technology, Beytepe Campus, Ankara, Turkey

- **Subjects:** 21m Elite 100m Sprinters (10.8-11.39s)
- **Methods:** Various vertical and horizontal jumping measures were correlated with max velocity achieved during a 100m sprint
- **Results:** The greatest significant correlation was seen between the Depth Jump Height (30-80cm) and Max Velocity Sprinting (r = 0.69*)
- **Conclusion:** Depth Jumps may be a positive predictor of max velocity sprinting in addition to a training method to improve vertical jump height

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Relationships between the muscle fiber characteristics, sprinting and jumping of sprinters

A. MERO

Biology of Sport Vol. 2, No. 3, 1985

University of Jyväskylä, Department of Biology of Physical Activity, Finland

- **Subjects:** 25m elite 100m elite sprinters (10.2-11.8s)
- **Methods:** 30m flying sprint and 10cm-1m Depth Jumps
- **Results/Conclusion:**
  - High correlation (r=0.72*) was found between Depth Jump height at 50cm and max velocity sprinting, suggesting that the Depth Jump can be a good predictor of max velocity running speed in elite sprinters
  - This may be related to similarities in GCT (<200ms)

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Horizontal Jumping vs. Sprinting

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PREDICTION MODELS OF SPEED AND AGILITY IN NFL COMBINE ATTENDEES

B. P. FAIRCHILD,[1] W. E. AMONETTE,[1] AND B. A. SPIERING[2]

[1]University of Houston Clear Lake, Houston, TX; and [2]California State University, Fullerton, CA

- **Subjects:**
  - Combined data from 2003 and 2008 NFL Combine (Football)
  - 2003 203m
  - 2008 243m
- **Methods:** The VJ, BJ, and Body Mass were correlated with performance during a 40yd sprint (10, 20, 40yd splits), Pro-Agility, and 3-Cone Drill
- **Results:** BJ significantly correlated with 10yd (r= -0.73*), 20yd (r= -0.73*), 40yd (r= -0.80*), Pro-Agility (r= -0.69*), and 3-Cone Drill (r= -0.63*)
- **Conclusion:** BJ and body mass were the best predictors of performance on linear and agility tests compared to the Vertical Jump and athlete Height

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Relationship Between the Kinetics and Kinematics of a Unilateral Horizontal Drop Jump to Sprint Performance

VOLUME 22 | NUMBER 5 | SEPTEMBER 2008 |

David Jonsson Holm,[1] Markus Stålbom,[1] Justin W. L. Keogh,[1] and John Cronin[1,2]

[1]Institute of Sport and Recreation Research New Zealand, School of Sport and Recreation, AUT University, Auckland, New Zealand; and [2]School of Exercise, Biomedical and Health Sciences, Edith Cowan University, Joondalup, Western Australia

- **Subjects:** 20m participating in various regional sports
- **Methods:** Single Leg Horizontal Drop Jump at 20cm (SLDJ) was correlated to 5, 10, and 25m sprints
- **Results:** The SLDJ correlated to all sprint distances with the greatest correlation seen with the 0-10m split (r= -0.61*)
- **Conclusion:** Unilateral horizontal jumping has a strong relationship with sprinting and should be used as a testing/training modality to improve acceleration

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The Relationship Between Kinematic Determinants of Jump and Sprint Performance in Division I Women Soccer Players

Kevin W. McCurdy,[1] John L. Walker,[1] George A. Langford,[2] Matt R. Kutz,[3] James M. Guerrero,[1] and Jeremy McMillan[1]

VOLUME 24 | NUMBER 12 | DECEMBER 2010 |

[1]Department of Health and Human Performance, Biomechanics Lab, Texas State University, San Marcos, Texas; [2]Department of Kinesiology and Physical Education, Human Performance Lab, Valdosta State University, Valdosta, Georgia; and [3]School of Human Movement, Sport, and Leisure Studies, Bowling Green State University, Bowling Green, Ohio

- **Subjects:** 15f NCAA D1 Soccer Players
- **Methods:** Various bilateral/unilateral horizontal and vertical jumps were correlated with 10m and 25m sprint times
- **Results:** Significant correlation between combined R/L leg Unilateral Vertical CMJ HT (r = -0.61*) for 25m and combined R/L leg Unilateral Horizontal Depth Jump (20cm) distance/height (r = -0.58*) for 10m
- **Conclusion:** Unilateral jumps may be a positive predictor of sprint speed in soccer athletes and horizontal jumps may be better at predicting 10m sprint times

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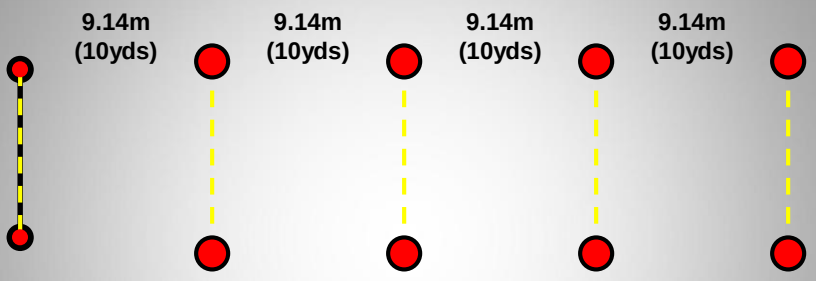
Sprinting and Jumping Relationship…



Unilateral-Bilateral Horizontal Jumping

Unilateral-Bilateral Depth (Vertical) Jumping

Squat Jump ↔ Countermovement Jump

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Agility vs. Jumping-Sprinting

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Relationships between sprinting, agility, and jump ability in female athletes

Journal of Sports Sciences, January 1st 2008; 26(1): 97 – 107

JASON D. VESCOVI[1] & MICHAEL R. McGUIGAN[2]

[1]*Department of Kinesiology, University of Connecticut, Storrs, CT, USA and* [2]*School of Exercise, Biomedical and Health Sciences, Edith Cowan University, Perth, WA, Australia*

- **Subjects:** 83f High School Soccer (HS), 51f College Soccer (CS), and 79f College Lacrosse (CL)
- **Methods:**
  - Sprint: 9.1, 18.3, 27.4, 36.6m (splits)
  - CMJ
  - Illinois Agility Drill
  - Pro-Agility Drill

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- **Results:**
  - **CMJ/Sprinting:** Jump height was inversely related to sprint times, with the relationship strengthening over longer distances
    - (27.4-36.6m split- HS -0.575*, CS -0.788*, CL -0.759*)
  - **CMJ/Agility:** Jump height had weak correlation to agility tests
  - **Sprinting/Agility:** Sprint times had a weak-moderate correlation to agility tests, with the relationship strengthening over longer distances
    - (27.4-36.6m split- HS 0.653*, CS 0.711*, CL 0.831*)
- **Conclusion:**
  - Max Velocity Sprinting and Agility have common strength quality needs

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Relationship Between Strength, Power, Speed, and Change of Direction Performance of Female Softball Players

VOLUME 24 | NUMBER 4 | APRIL 2010 |

Sophia Nimphius,[1] Michael R. Mcguigan,[2,3] and Robert U. Newton[1]

[1]*School of Exercise, Biomedical and Health Sciences, Edith Cowan University, Joondalup, Australia;* [2]*New Zealand Academy of Sport North Island, Auckland, New Zealand; and* [3]*Sport Performance Research Institute New Zealand, School of Sport and Recreation, AUT University, Auckland, New Zealand*

- **Subjects:** 10f Softball Players (Australian Institute of Sport)
- **Methods:** Pre, Mid, and Post testing
  - 3RM Testing (Relative Strength: Predicted 1RM/BW)
  - CMJ BW, +40%1RM, +60% 1RM, +80%1RM
  - Sprint (Split: 10m, 17.9m (1st Base), 35.8m (2nd Base))
  - 5-0-5 Agility Test

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- **Results/Conclusion:**
  - **1RM/Sprinting:** Strong correlation at all distances and across the season (Pre -0.87*, Mid -0.85*, Post -0.75*)
  - **1RM/Agility:** Strong correlation with non-dominant side across season (Pre -0.75*, Mid -0.73*, Post -0.85*)
  - **Sprinting/Agility:** Strong correlating across distances with non-dominant side across season (Pre 0.87*, Mid 0.89*, Post 0.99*)

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Sprinting, Jumping, Agility Relationship…

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Case Study

Apply Athletic Profiling to Soccer

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Visualizing: Athletic Profiling Data

- Graphing Relationships across Drills
  - Individual vs. Position (Norms)
  - Individual vs. Position (Current)
  - Individual vs. Team
  - Individual vs. Individual
- Powerful for coaches
  - Data is turned into a visual relationship

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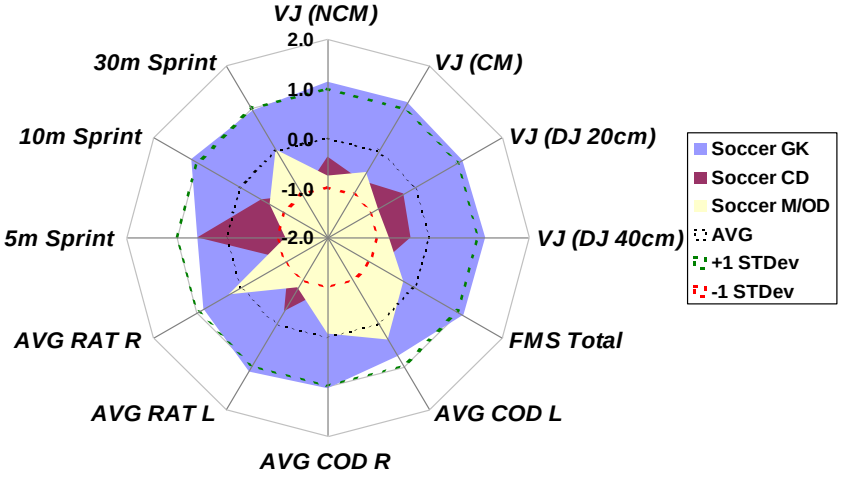
SOCCER_Athletic Profile for GK, CD, and M



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Additional Profiling Considerations

- Energy System Measures
  - VO2
  - AT
  - Repeat Sprint
- Isometric Strength (Grip Strength)
- ROM/Strength Symmetry
- FMS
- Anthropometric

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Take Home Message…

- Use athletic profiling to capture different motor abilities with common strength and movement needs
- Results create a common profile for work on the field and needs within the weight room
- Athletic profiling drives prioritization and maximizes our time spent with athletes

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