Applications of GPS in rugby union matches and training

World Rugby Science Network Conference 2015

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LIONS

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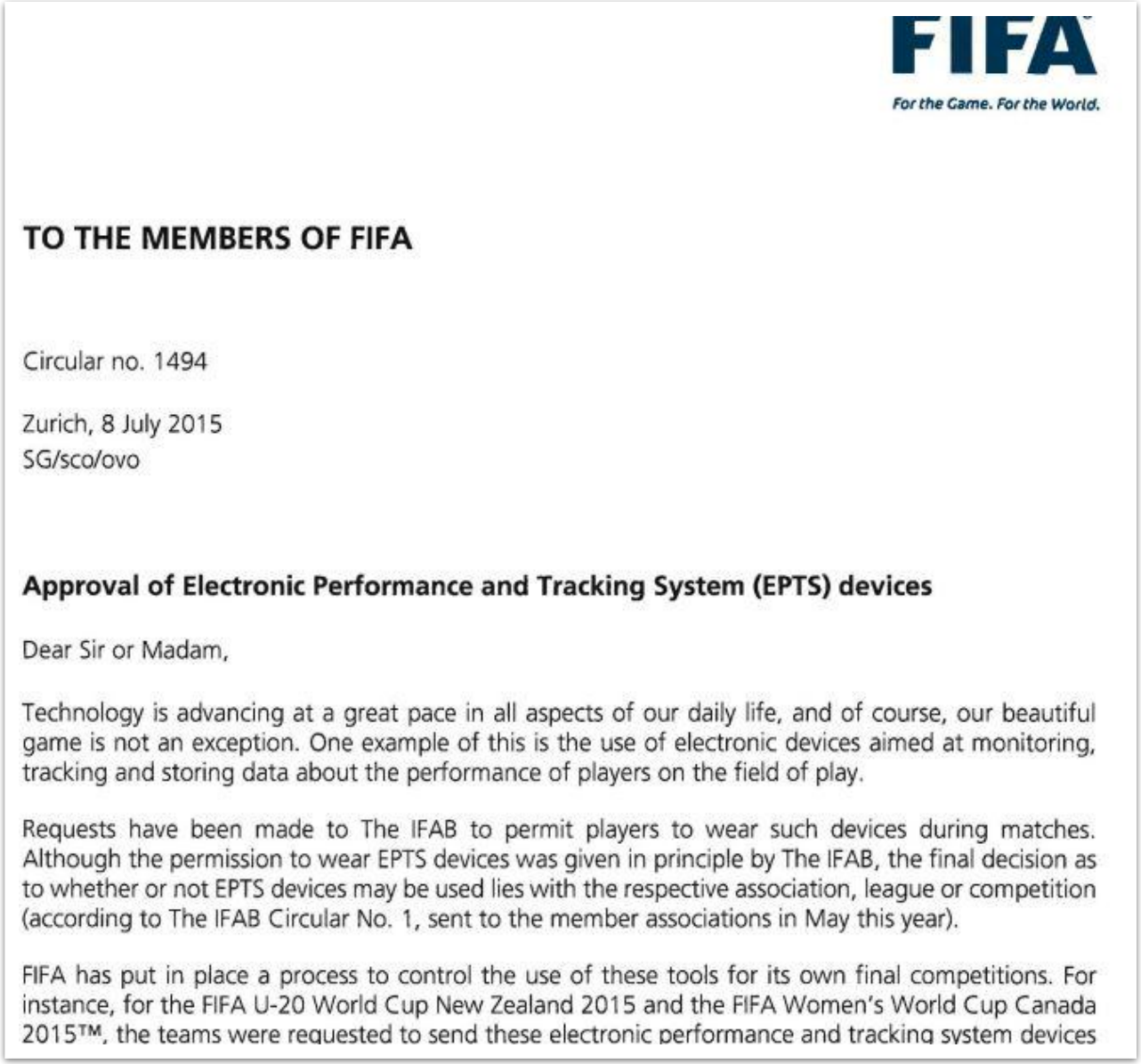
NRF

GPS is here to stay

Investment from football will likely lead to rapid advances in

- Validity and reliability of tracking
- Automation of analysis
- Live tracking applications



FIFA
For the Game. For the World.

TO THE MEMBERS OF FIFA

Circular no. 1494

Zurich, 8 July 2015
SG/sco/ovo

Approval of Electronic Performance and Tracking System (EPTS) devices

Dear Sir or Madam,

Technology is advancing at a great pace in all aspects of our daily life, and of course, our beautiful game is not an exception. One example of this is the use of electronic devices aimed at monitoring, tracking and storing data about the performance of players on the field of play.

Requests have been made to The IFAB to permit players to wear such devices during matches. Although the permission to wear EPTS devices was given in principle by The IFAB, the final decision as to whether or not EPTS devices may be used lies with the respective association, league or competition (according to The IFAB Circular No. 1, sent to the member associations in May this year).

FIFA has put in place a process to control the use of these tools for its own final competitions. For instance, for the FIFA U-20 World Cup New Zealand 2015 and the FIFA Women's World Cup Canada 2015™, the teams were requested to send these electronic performance and tracking system devices

Comparison
GPS vs. automated camera systems

GPS
(e.g. GPSports, Catapult)

- Portable (matches and training)
- Use with youth and academy players
- Cost effective relative to camera systems

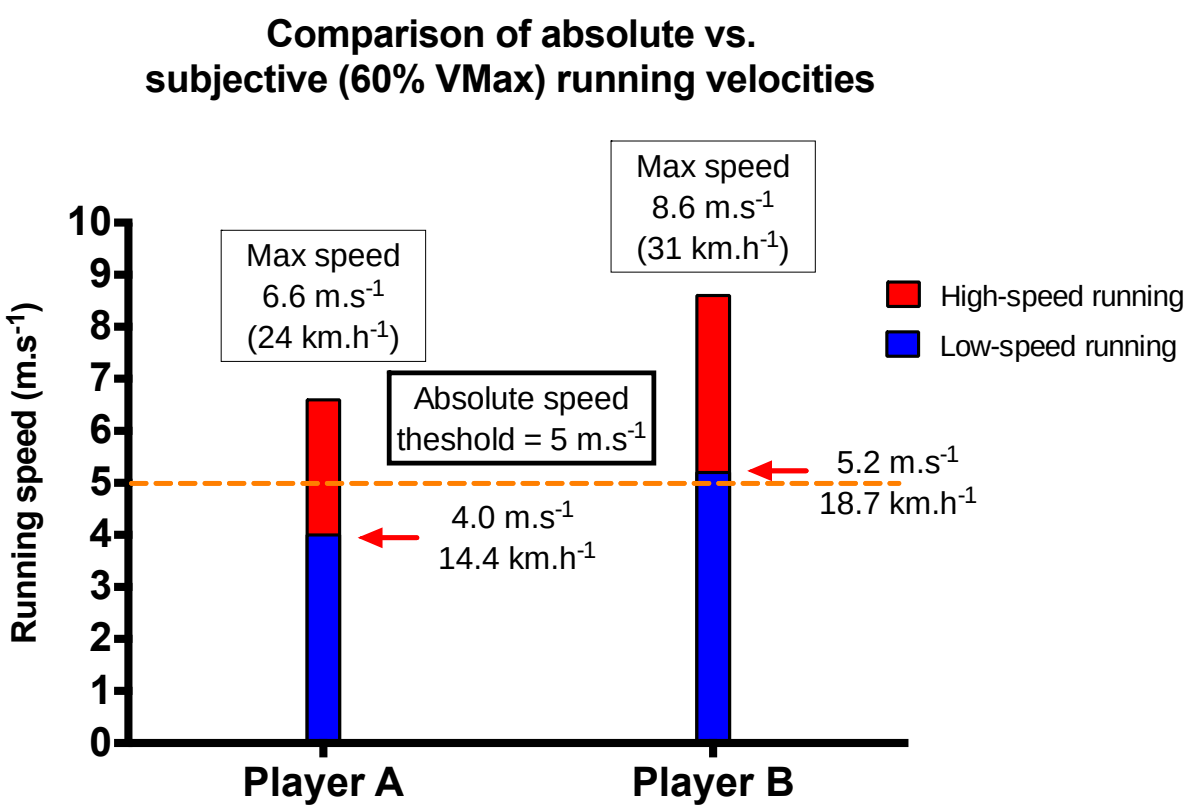
Semi-automated camera systems
(e.g. Prozone)

- Stadium dependent
- Often home match data only
- Expensive

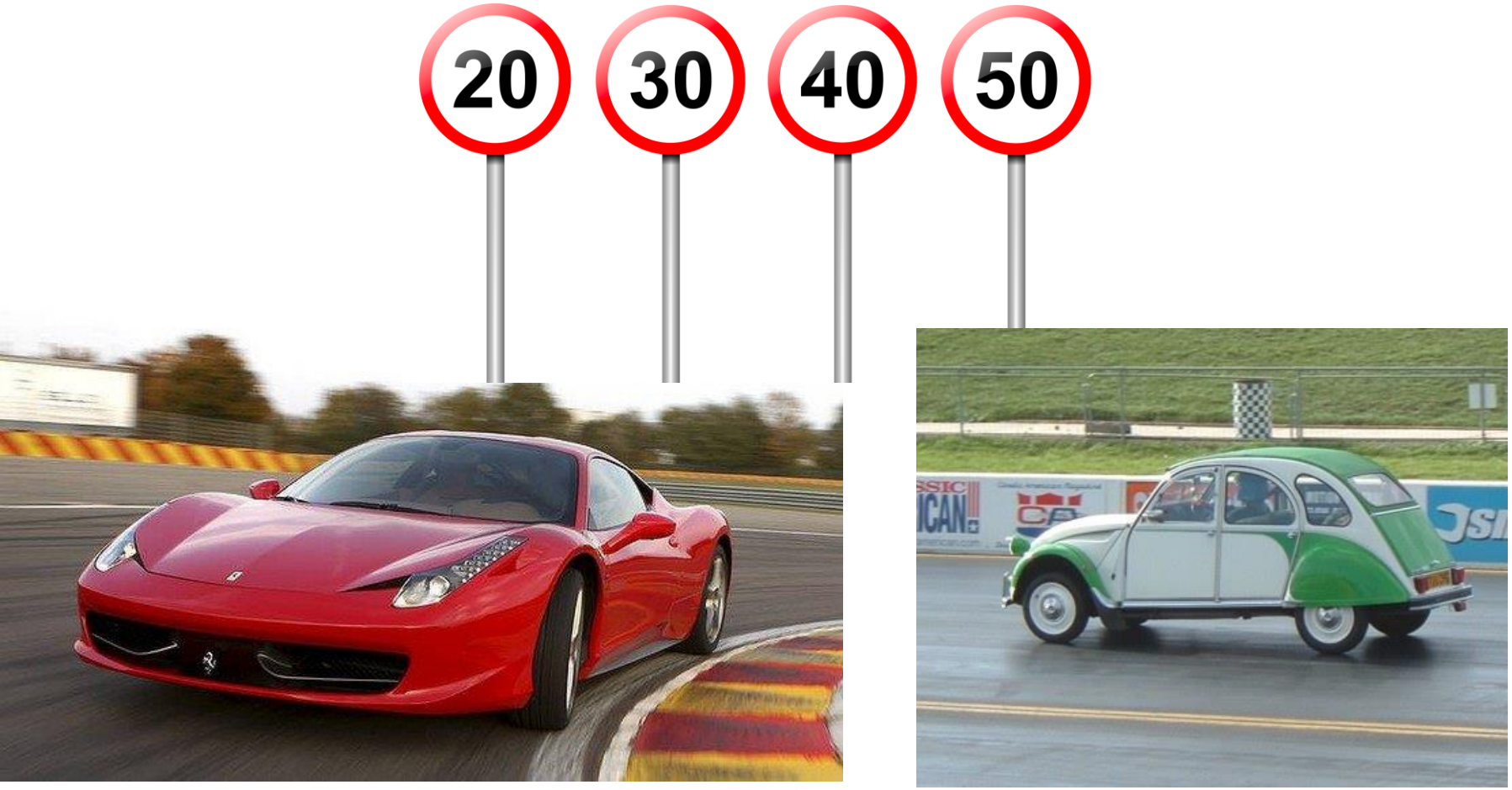
Absolute vs. subjective speed thresholds

"Individualisation of velocity bands increases the high-speed running attributed to slower players and decreases the high-speed running attributed to faster players."

Gabbett (2015) JSCR



Absolute vs. relative speed thresholds



Normative data

Journal of Sports Sciences
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rjsp20

The movement characteristics of English Premiership rugby union players

Nicola Cahill [a] , Kevin Lamb [a] , Paul Worsfold [a] , Roy Headey [b] & Stafford Murray [c]
[a] University of Chester, Sport and Exercise Sciences, Chester, UK
[b] Rugby Football Union, Twickenham, UK

European Journal of Sport Science
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Quantifying positional and temporal movement patterns in professional rugby union using global positioning system

Marc R. Jones[ab], Daniel J. West[c], Blair T. Crewther[d], Christian J. Cook[e] & Liam P. Kilduff[a]

ORIGINAL RESEARCH

CrossMark
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Movement and impact characteristics of South African professional rugby union players

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Professional rugby match GPS norms

Table 1 - Representative sample of data from professional rugby union match play

	Forwards	Backs
Relative distance ($m.min^{-1}$)	69 ± 8	69 ± 9
Maximum speed ($m.s^{-1}$)	7.6 ± 1.3	8.8 ± 1.1
Low-speed distance ($m.min^{-1}$ <4$m.s^{-1}$)	58 ± 7	56 ± 6
High-speed distance ($m.min^{-1}$ >4$m.s^{-1}$)	11 ± 5	14 ± 4
Repeated high intensity efforts (RHIE)	12 ± 8	6 ± 6

Data compiled from Tee et al., (2015) SAJSM and Jones et al., (2015) Eur J Sport Sci

* Significant differences regularly found between players in different positions

Professional rugby training GPS norms

Table 2 – Typical training variables during a 1 week micro-cycle for professional rugby union players

	Forwards	Backs
Total distance (m)	7800 ± 950	9600 ± 1200
Low-speed distance (m <4.4m.s^{-1})	6950 ± 900	7900 ± 1300
High-speed distance (m >4.4m.s^{-1})	850 ± 350	1550 ± 500
Repeated high intensity efforts (RHIE)	19 ± 8	15 ± 10

Data compiled from Bradley et al., (2015) Eur J Sport Sci

* Significant differences regularly found between players in different positions

Variability of physical performance and player match loads in professional rugby union

Shaun J. McLaren[a], Matthew Weston[a], Andrew Smith[b,c], Rob Cramb[d], Matthew D. Portas[a,*]

Forwards

	Within-player CV (%; ±90% CL)	Between-player CV (%; ±90% CL)
Absolute physical performance		
TD (m)	10.0; ±2.1	5.5; ±1.5
LSR (m)	8.7; ±1.9	2.2; ±5.3
HSR (m)	27.6; ±6.9	16.5; ±5.1
VHSR (m)	68; ±19	58; ±63
TI (*n*)	24.0; ±5.9	15; ±16
RHIE (*n*)	18.7; ±4.4	16; ±12

Backs

	Within-player CV (%; ±90% CL)	Between-player CV (%; ±90% CL)
Absolute physical performance		
TD (m)	10.8; ±2.1	6.7; ±4.7
LSR (m)	10.1; ±2.0	6.1; ±4.4
HSR (m)	20.1; ±4.1	32; ±19
VHSR (m)	34.1; ±7.5	19; ±17
TI (*n*)	36.4; ±7.9	39; ±22
RHIE (*n*)	39.5; ±8.8	47; ±31

Reasons for large variability

Reliability of measurement

- At low-speeds (<4m.s^{-1}) GPS units display adequate reliability (CV < 3.0%)
- At high-speeds (>4m.s^{-1}) data "interpreted with caution"

  (CV 5 – 20%, depending on model)
- Petersen et al. (2009) *Int. J Sports Physiol Perform 4:3*

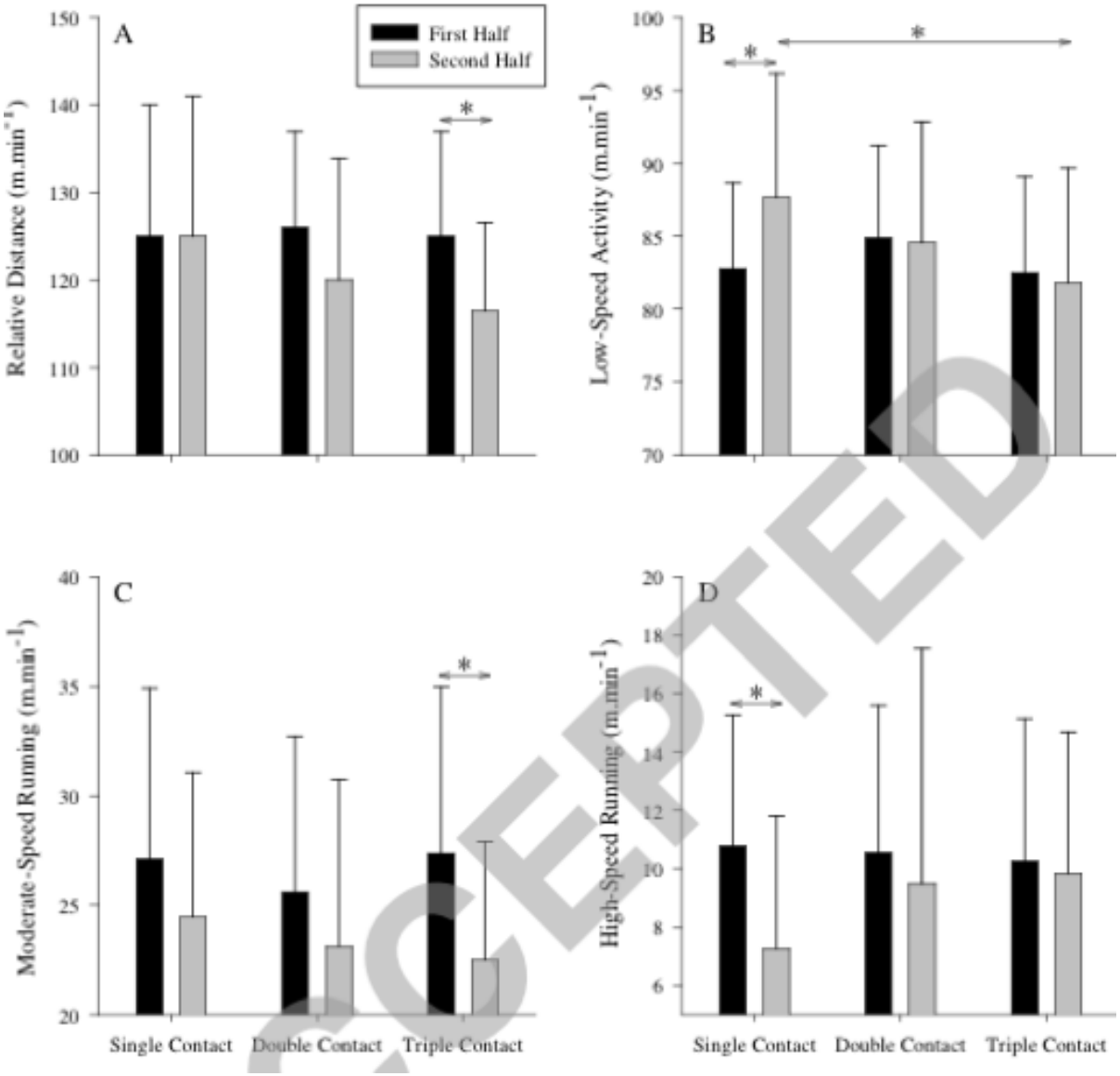
Game related factors

- Ambient conditions
- Opposition
- Match situation
- Contact

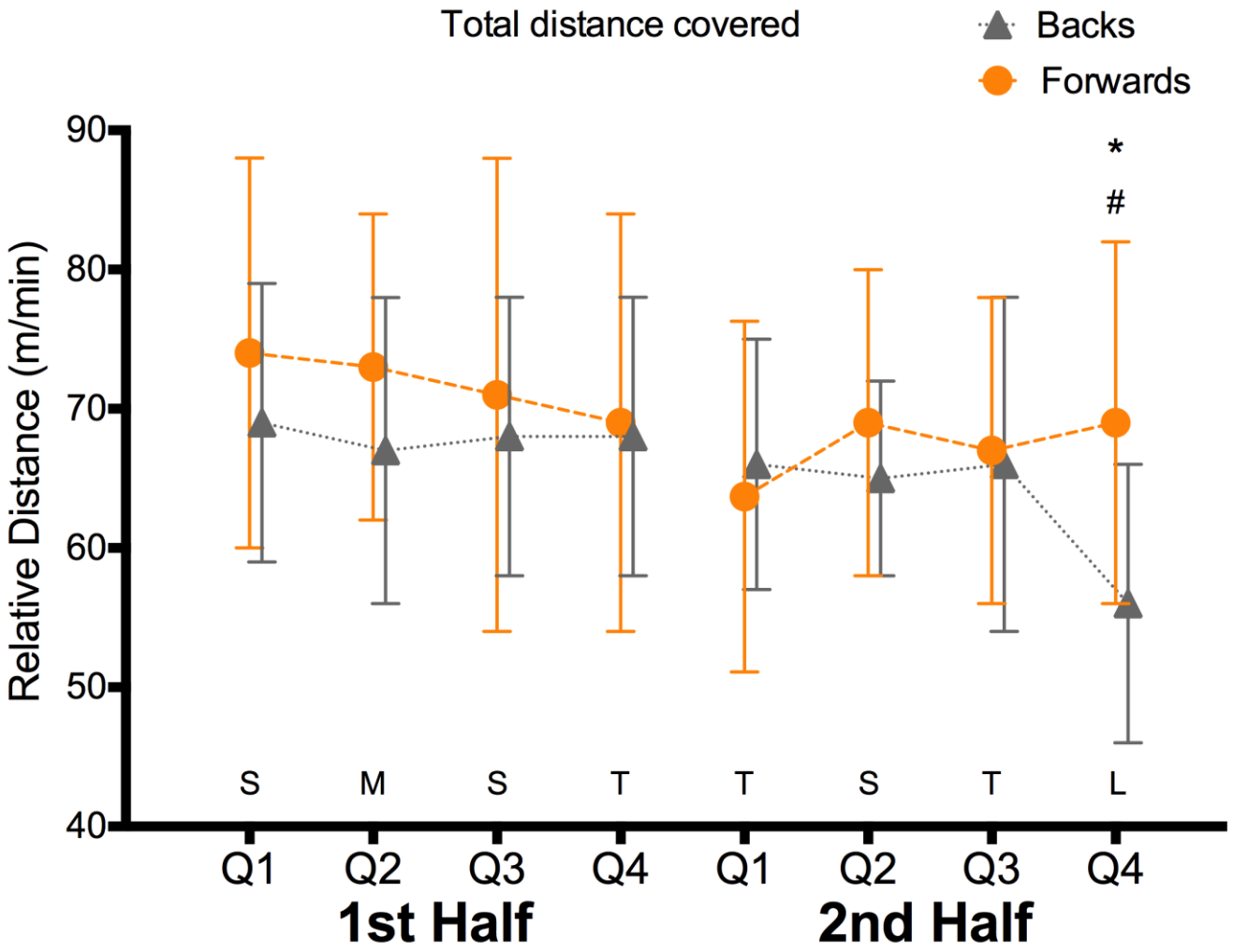
Contact

Increased contact leads to **reduced** total and high intensity **running distance** during game play –

Johnston et al., (2014) JSCR

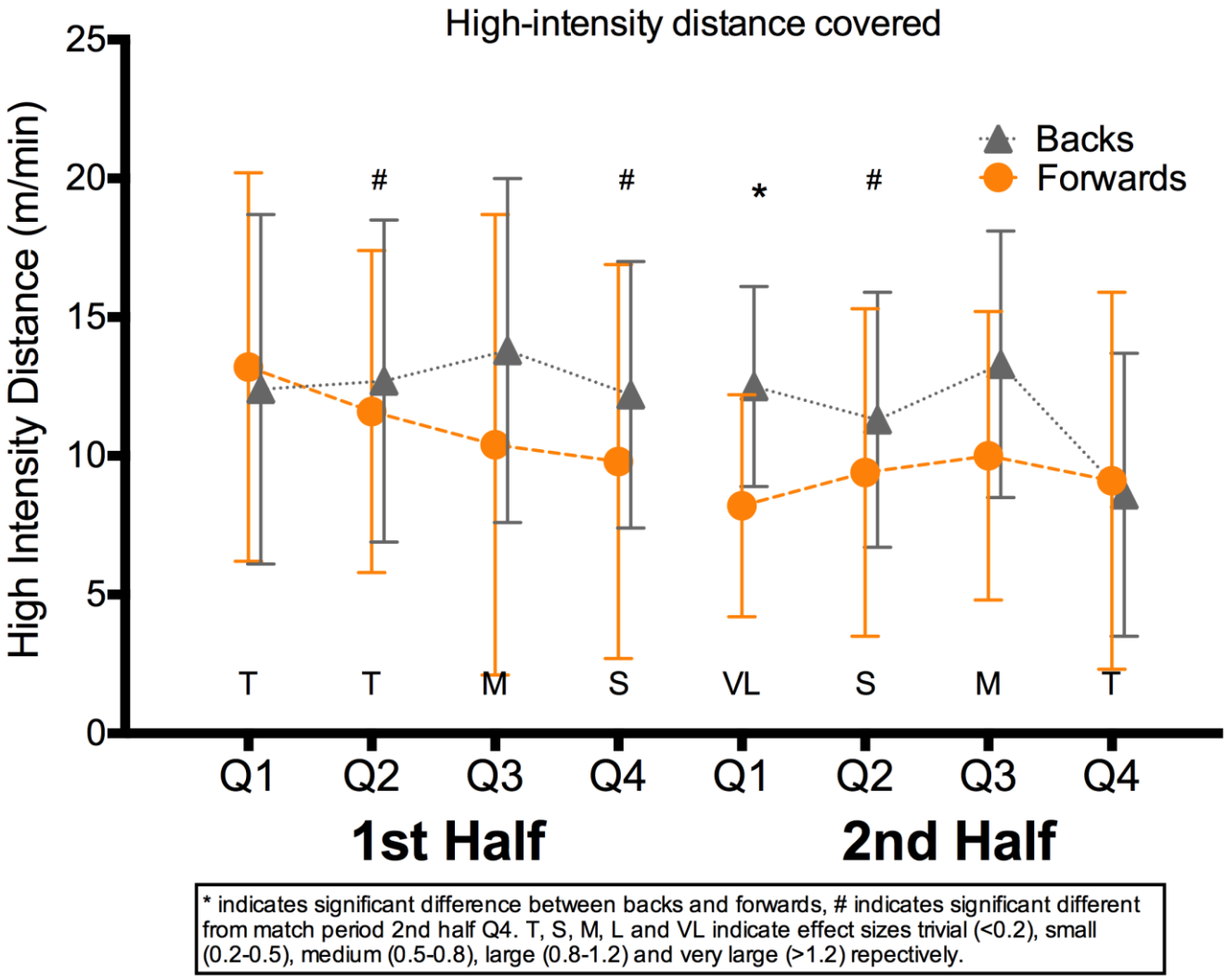


Match applications - pacing



* indicates significant difference between backs and forwards, # indicated significant different from all othe match periods. T, S, M, L and VL indicate effect sizes trivial (<0.2), small (0.2-0.5), medium (0.5-0.8), large (0.8-1.2) and very large (>1.2) repectively.

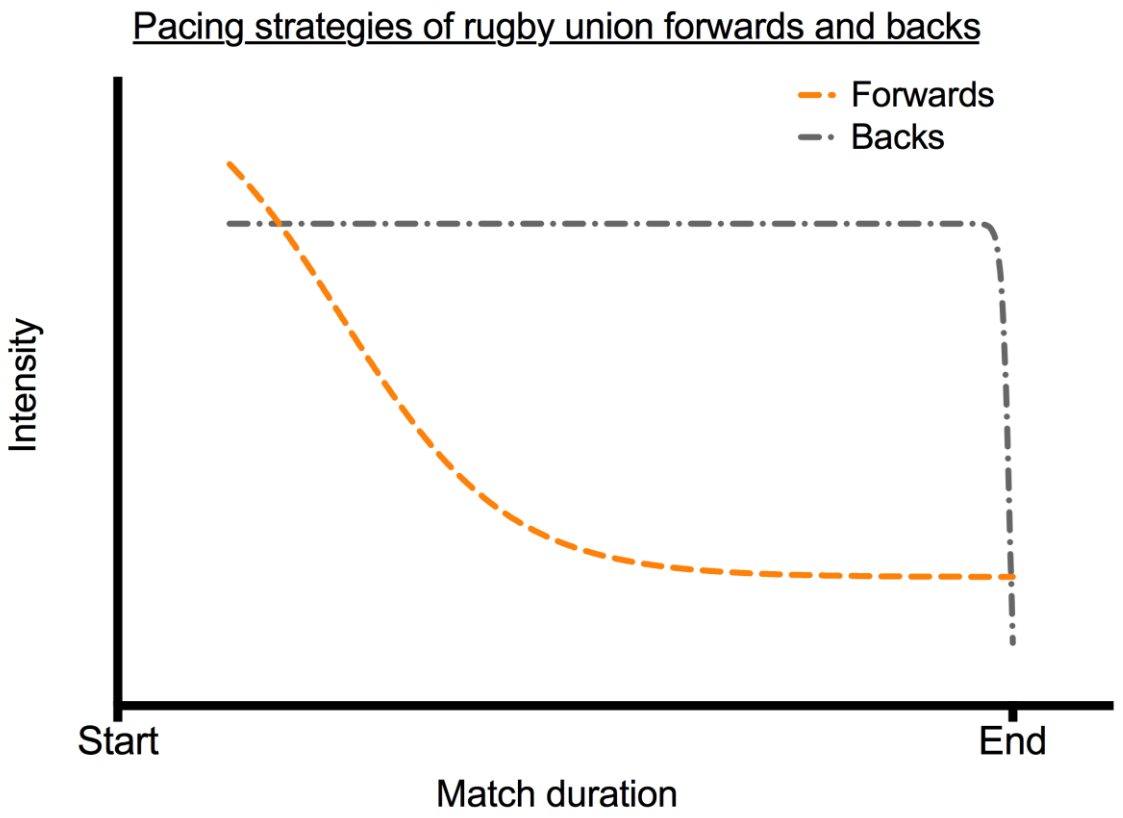
Match applications - pacing



* indicates significant difference between backs and forwards, # indicates significant different from match period 2nd half Q4. T, S, M, L and VL indicate effect sizes trivial (<0.2), small (0.2-0.5), medium (0.5-0.8), large (0.8-1.2) and very large (>1.2) repectively.

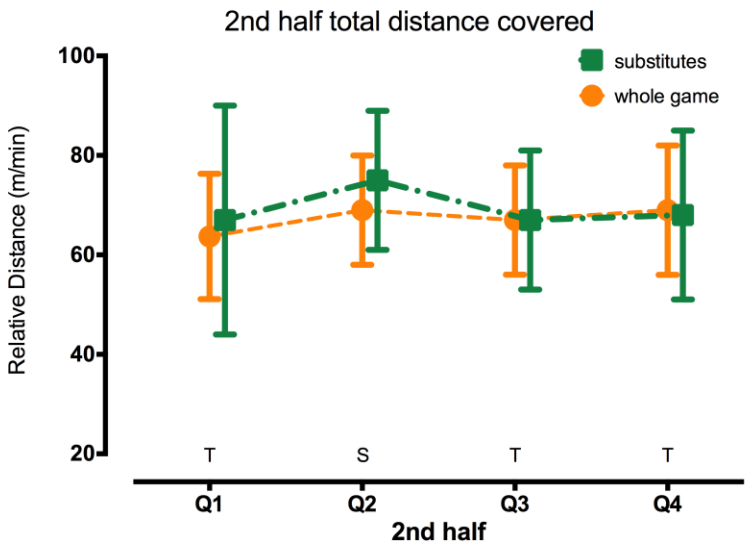
Tee (PhD Thesis)

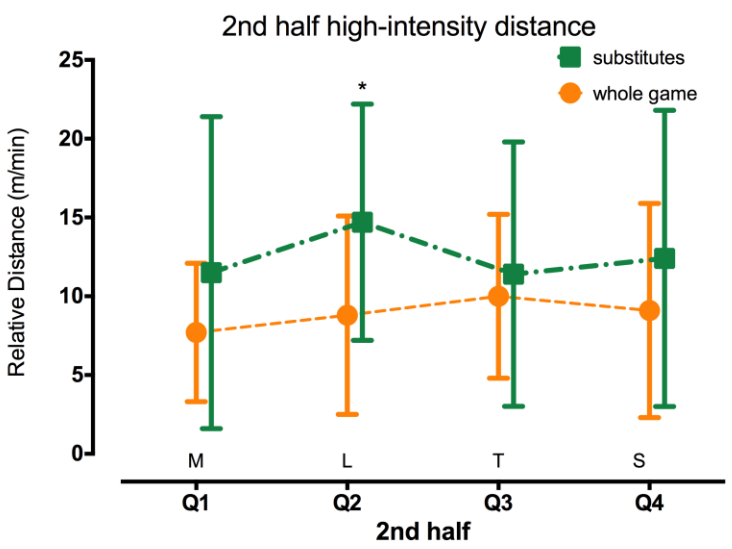
Match Applications – fatigue profile

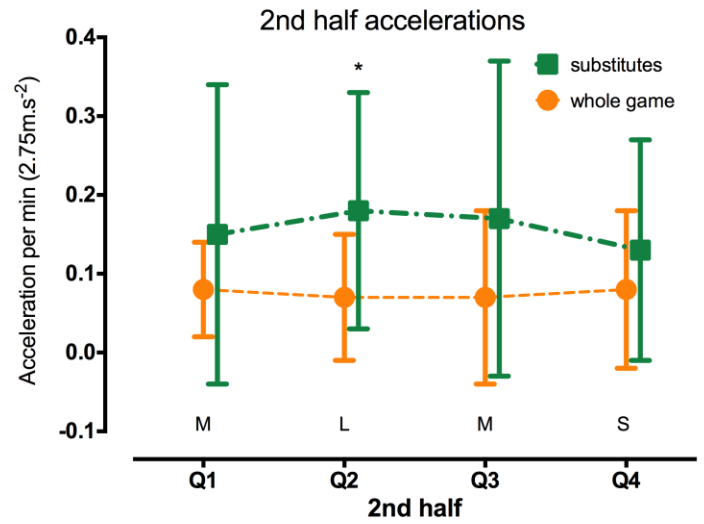


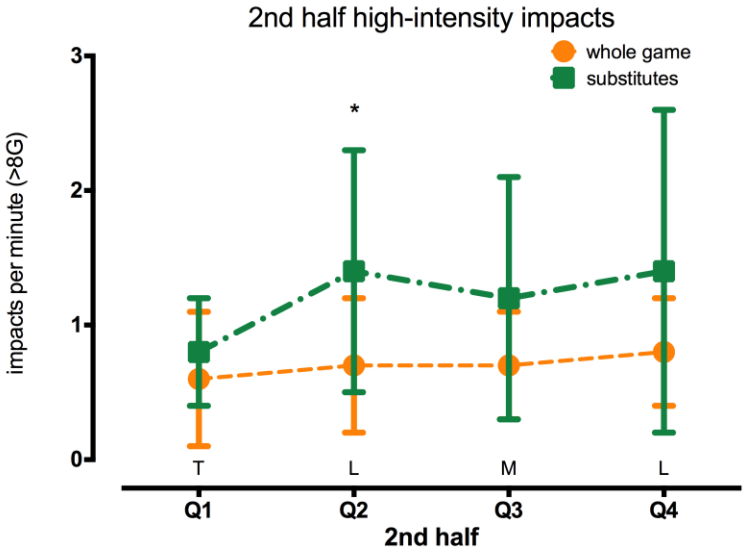
Pacing profile	
Forwards	**Backs**
"Slow positive"	"Flat"

Match Applications – effect of substitutes









* indicates significant difference between whole game players and substitutes. T, S, M, L and VL indicate effect sizes trivial (<0.2), small (0.2-0.5), medium (0.5-0.8), large (0.8-1.2) and very large (>1.2) repectively.

Match applications –

Measuring exertion

- Determine fatigue and modify recovery protocols
- Determine metabolic power (kJ/kg)
- Estimate energy expenditure adequate energy replacement

Determining physical demands at various standards of play

Physical Demands of Competition

- Average Demands
  - Work:rest ratio ~ 1:5
  - ~100-120 m/min

- Worst Case Scenario
  - Work:rest ratio ~3:1
  - ~160 m/min
  - Repeated-High-Intensity Effort Bouts

- Train for the average demands → under-prepared for the most demanding passages of play

Maximum match demands

Table 2 - Maximum observed values for movement variables during match play and percentage difference from average match play values for five positional groups.

	Tight Forwards	Loose Forwards	Scrumhalves	Inside Backs	Outside Backs
Relative distance ($m.min^{-1}$)	81 (15%)	86 (25%)	99 (23%)	86 (26%)	78 (17%)
Maximum speed ($m.s^{-1}$)	9.9 (36%)	10.8 (35%)	9.2 (15%)	9.4 (18%)	11.3 (20%)
Walking distance ($m.min^{-1}$)	45 (33%)	45 (47%)	41 (15%)	43 (17%)	41 (16%)
Jogging distance ($m.min^{-1}$)	39 (35%)	33 (37%)	33 (31%)	28 (36%)	25 (41%)
Striding distance ($m.min^{-1}$)	11 (59%)	20 (75%)	25 (53%)	14 (56%)	15 (71%)
Sprinting distance ($m.min^{-1}$)	1.5 (198%)	4.8 (128%)	5.8 (85%)	9.1 (276%)	7.3 (87%)
Sprint frequency	1 every 10 minutes (246%)	1 every 4 minutes (175%)	1 every 4 minutes (69%)	1 every 3 minutes (213%)	1 every 4 minutes (73%)
Acceleration frequency	1 every 7 minutes (86%)	1 every 3 minutes (159%)	1 every 3 minutes (41%)	1 every 2 minutes (185%)	1 every 3 minutes (63%)

Data from Tee et al., GPS comparison of training activities and match demands of professional rugby union, International Journal of Sport Science and Coaching (In press)

Determining training specificity

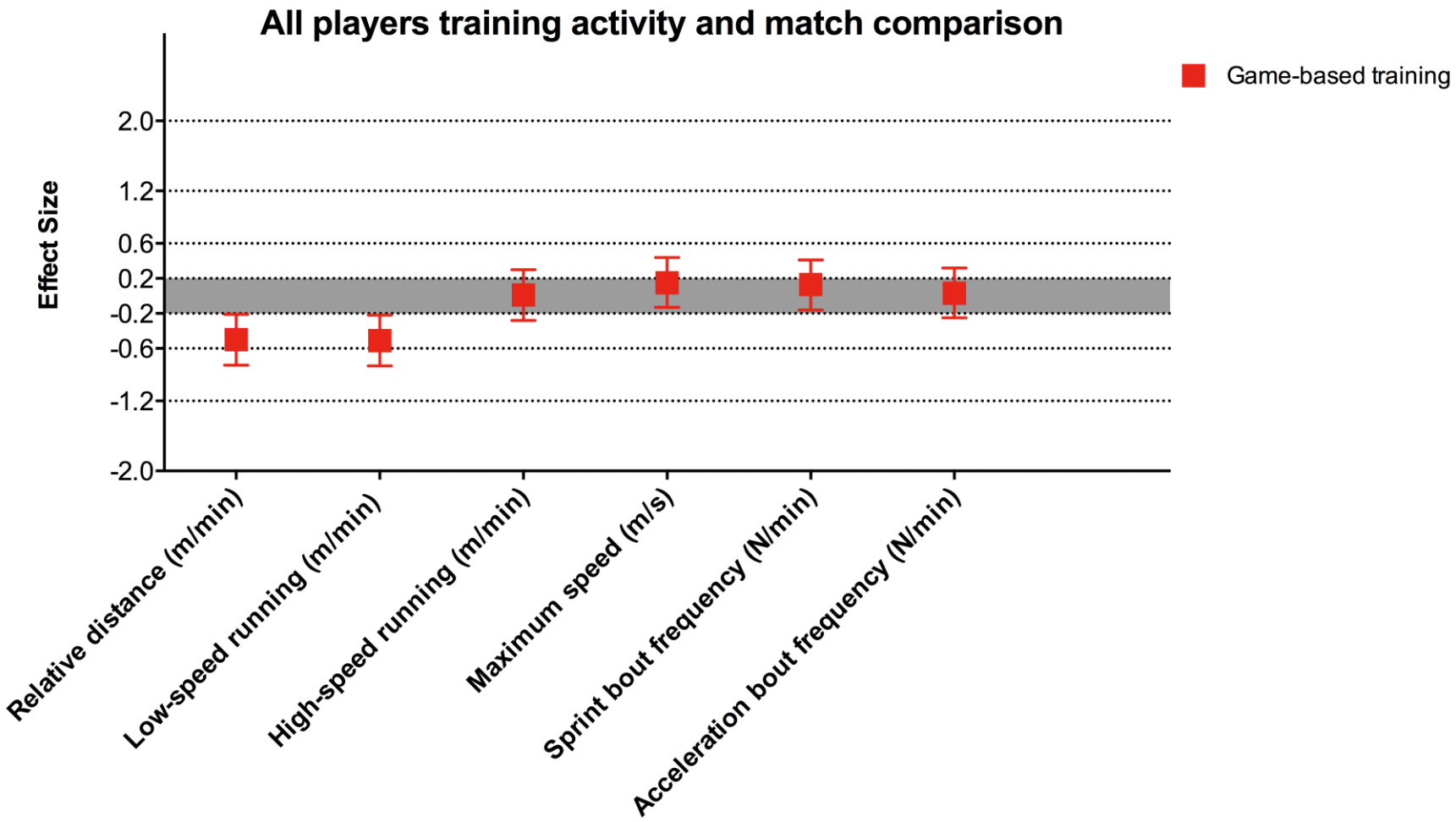
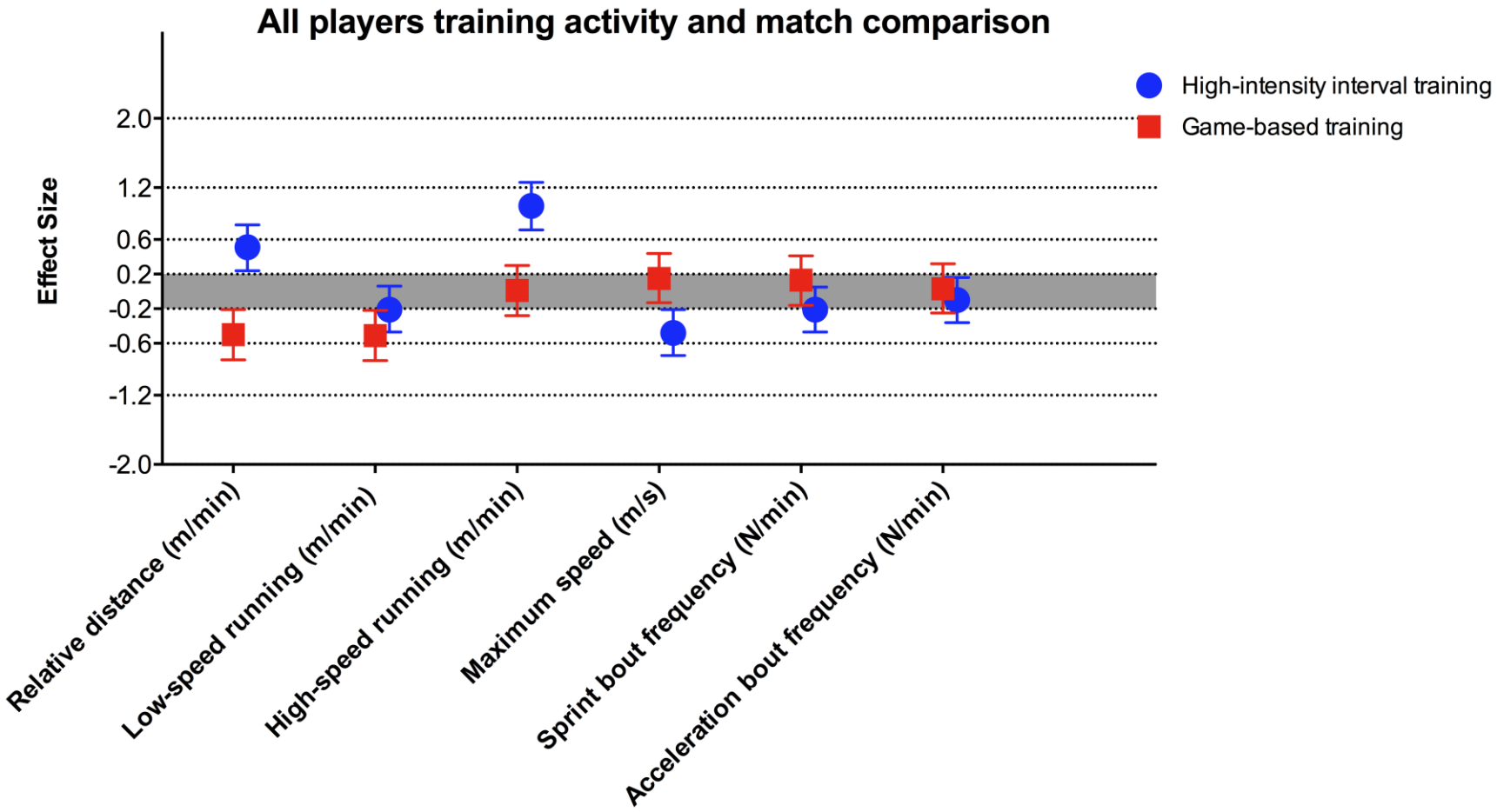


Figure 1 - Magnitude of differences between match exertions and common training activities

Data from Tee et al., GPS comparison of training activities and match demands of professional rugby union, International Journal of Sport Science and Coaching (In press)

Determining training specificity



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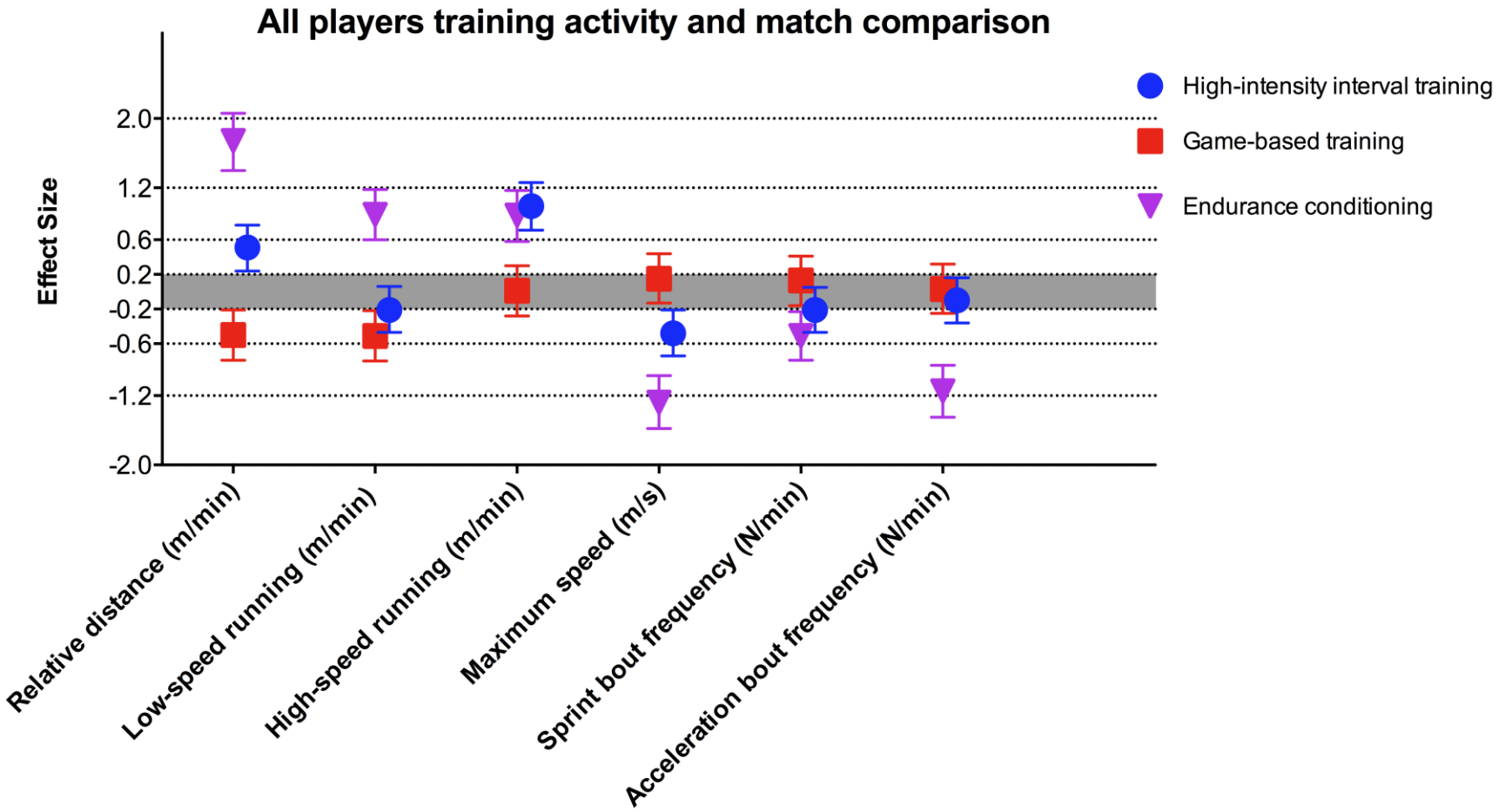

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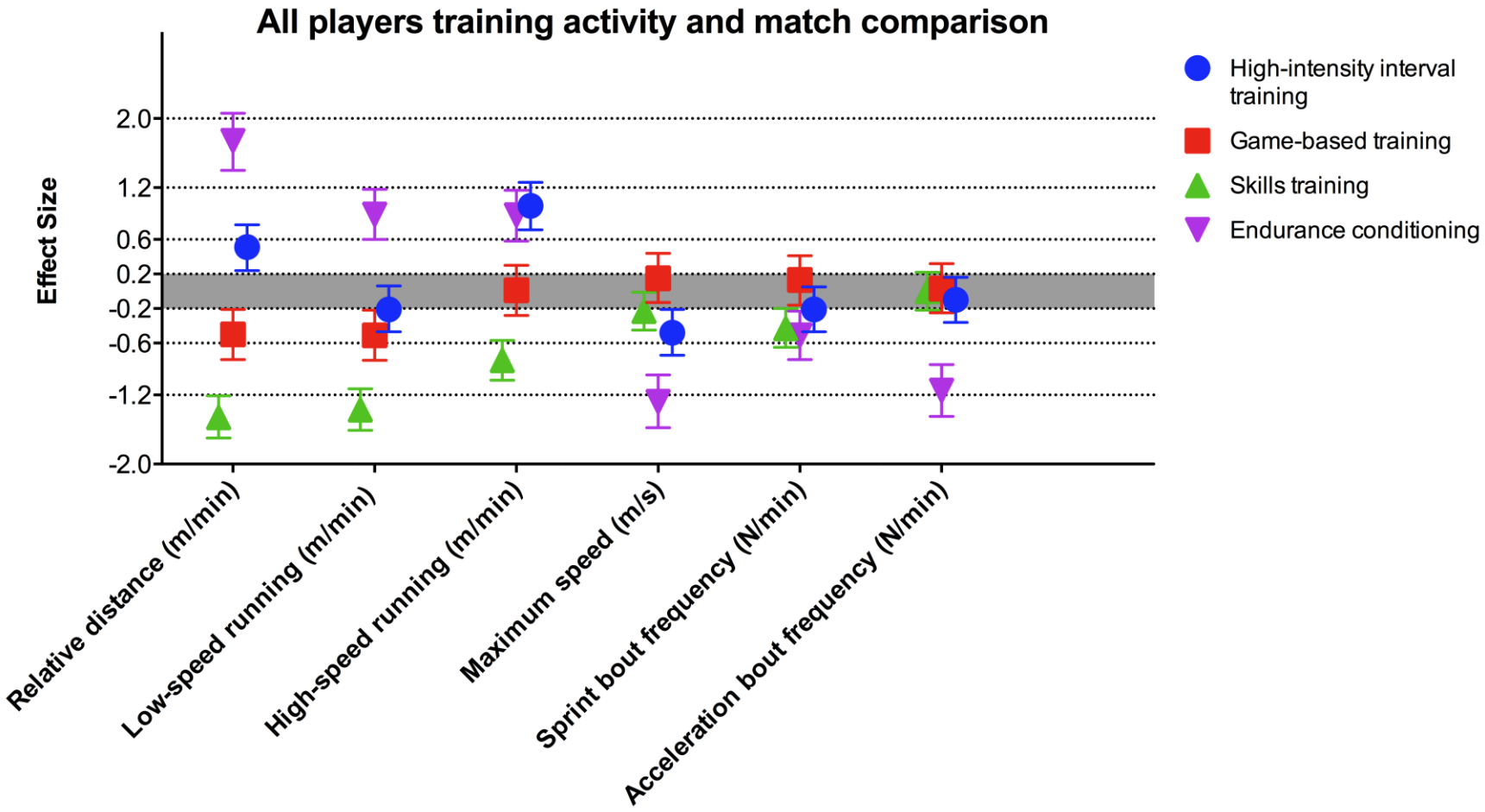

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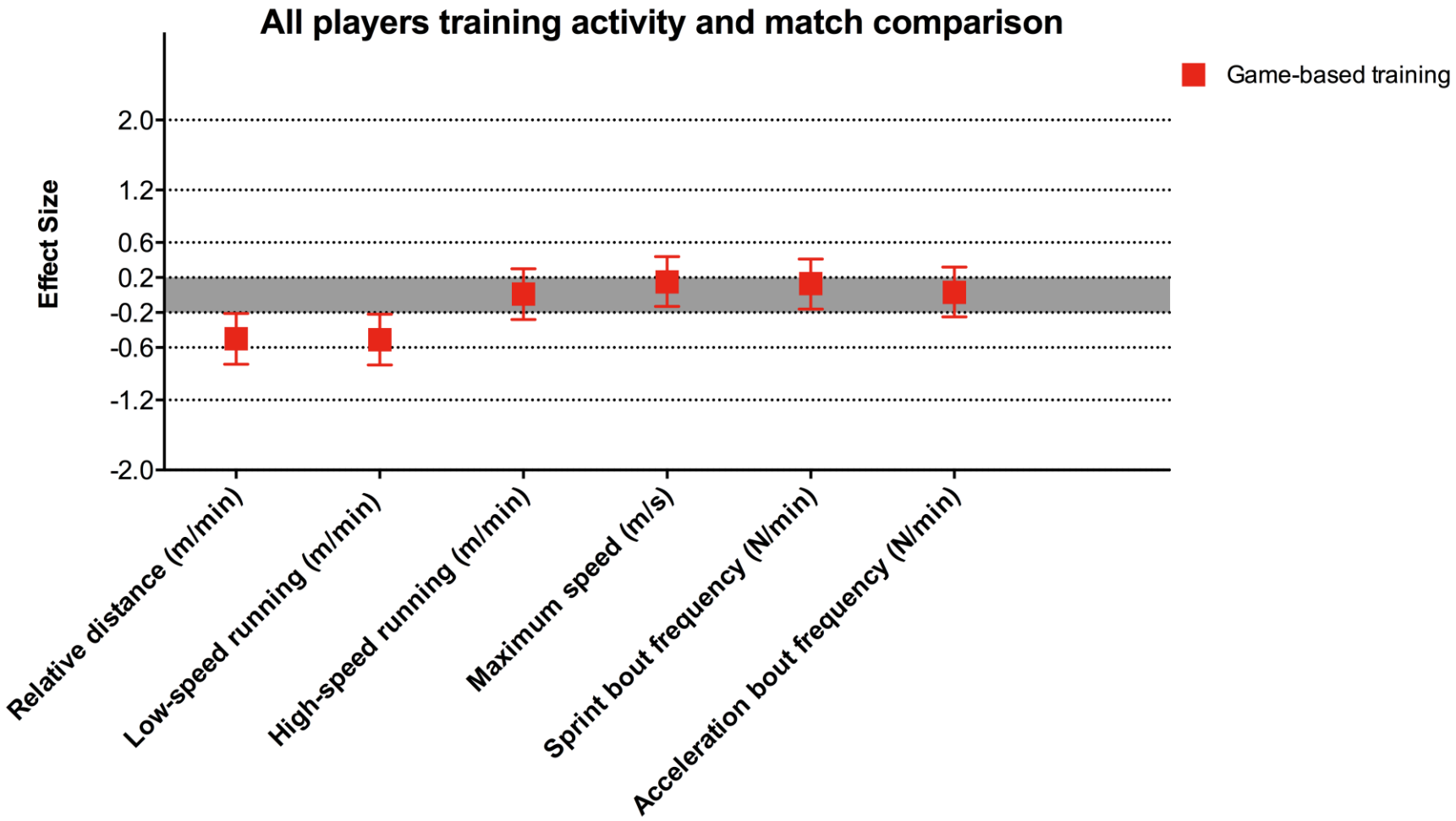
Diversity of Physical Requirements

There is a **diversity of skills and positional requirements** among rugby players

To ensure quality conditioning and recovery programs, it is essential to understand the **physical demands placed on players in different positions**

Training for positional specificity



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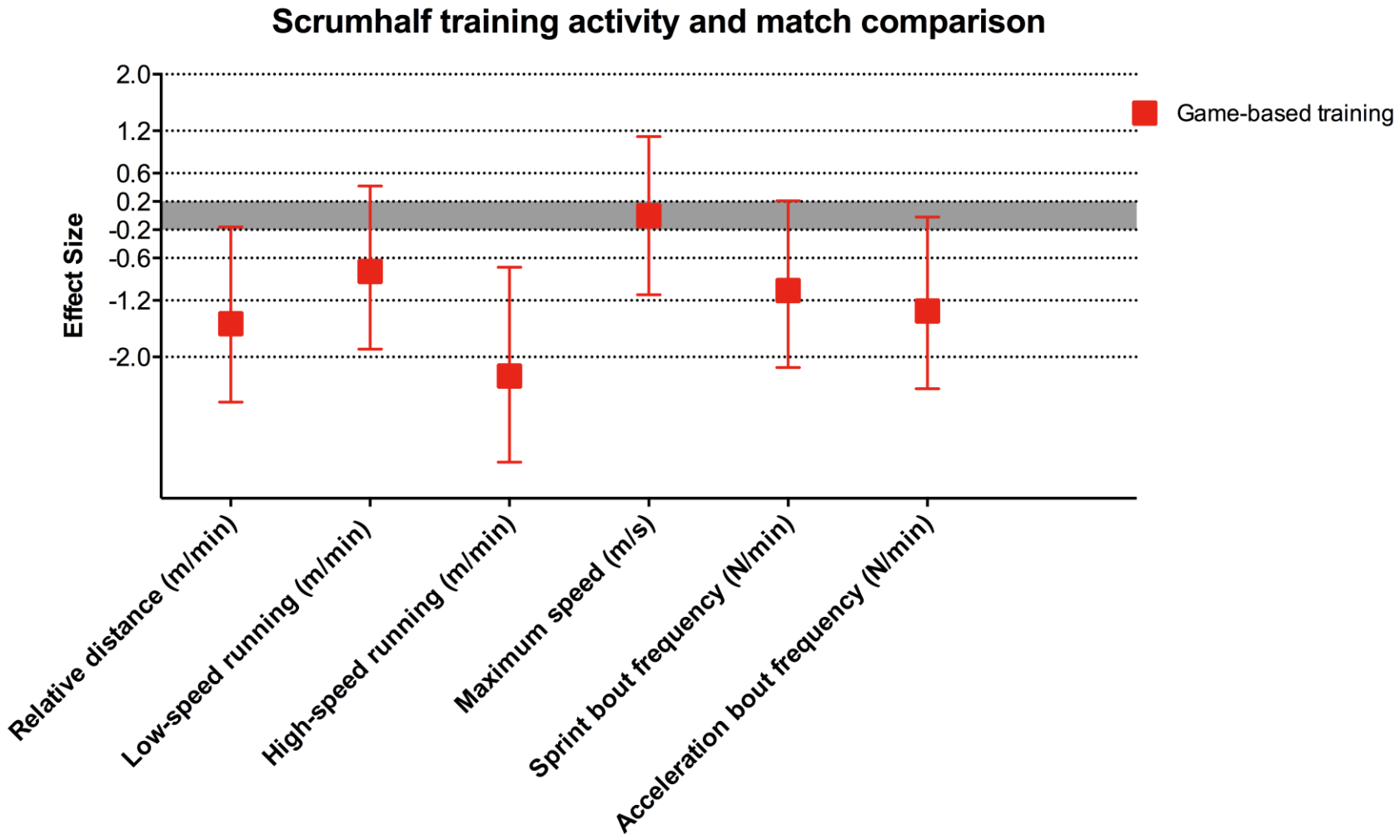

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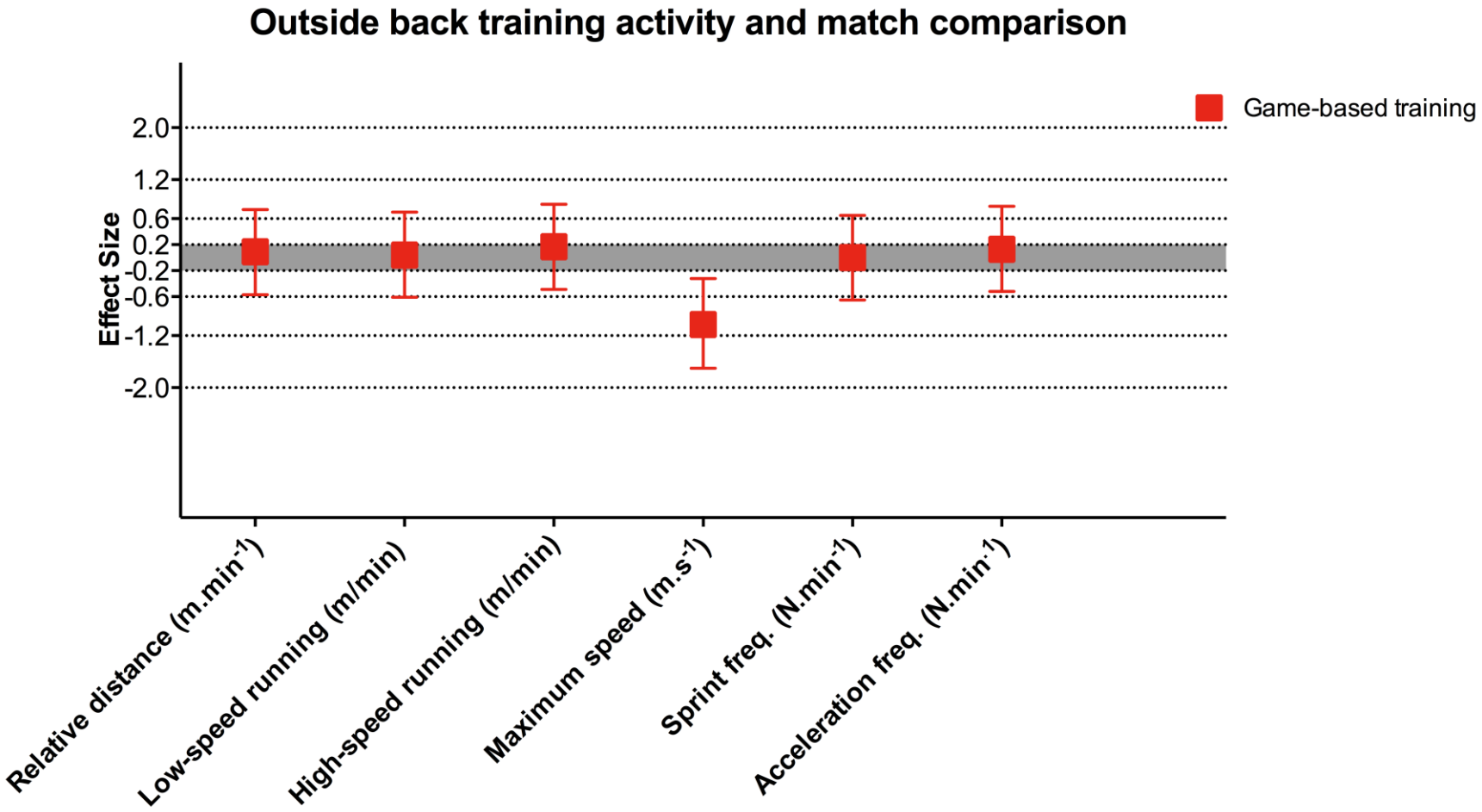

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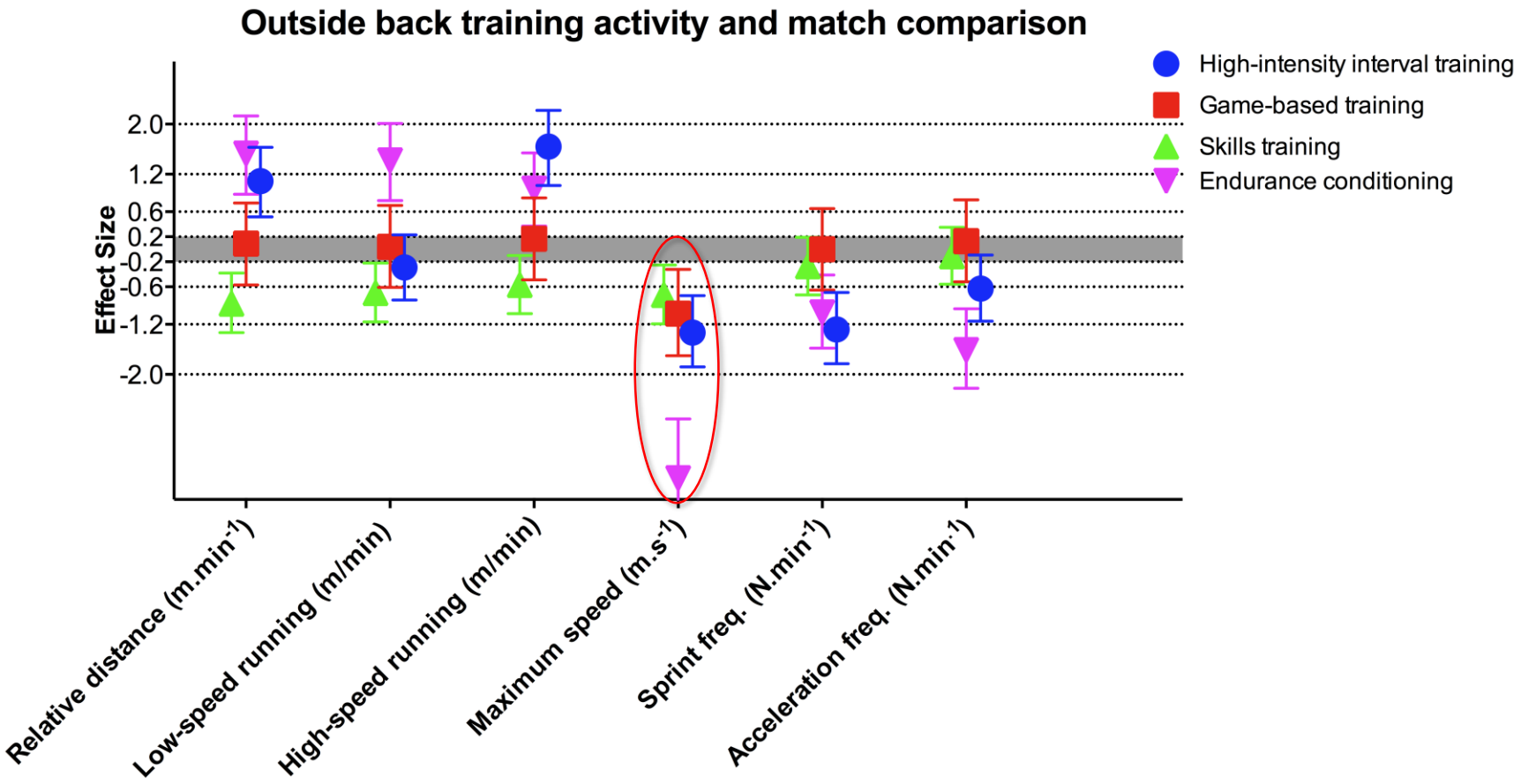

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Thanks for listening!

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