

# Intra-training recovery in football: the rest interval paradox

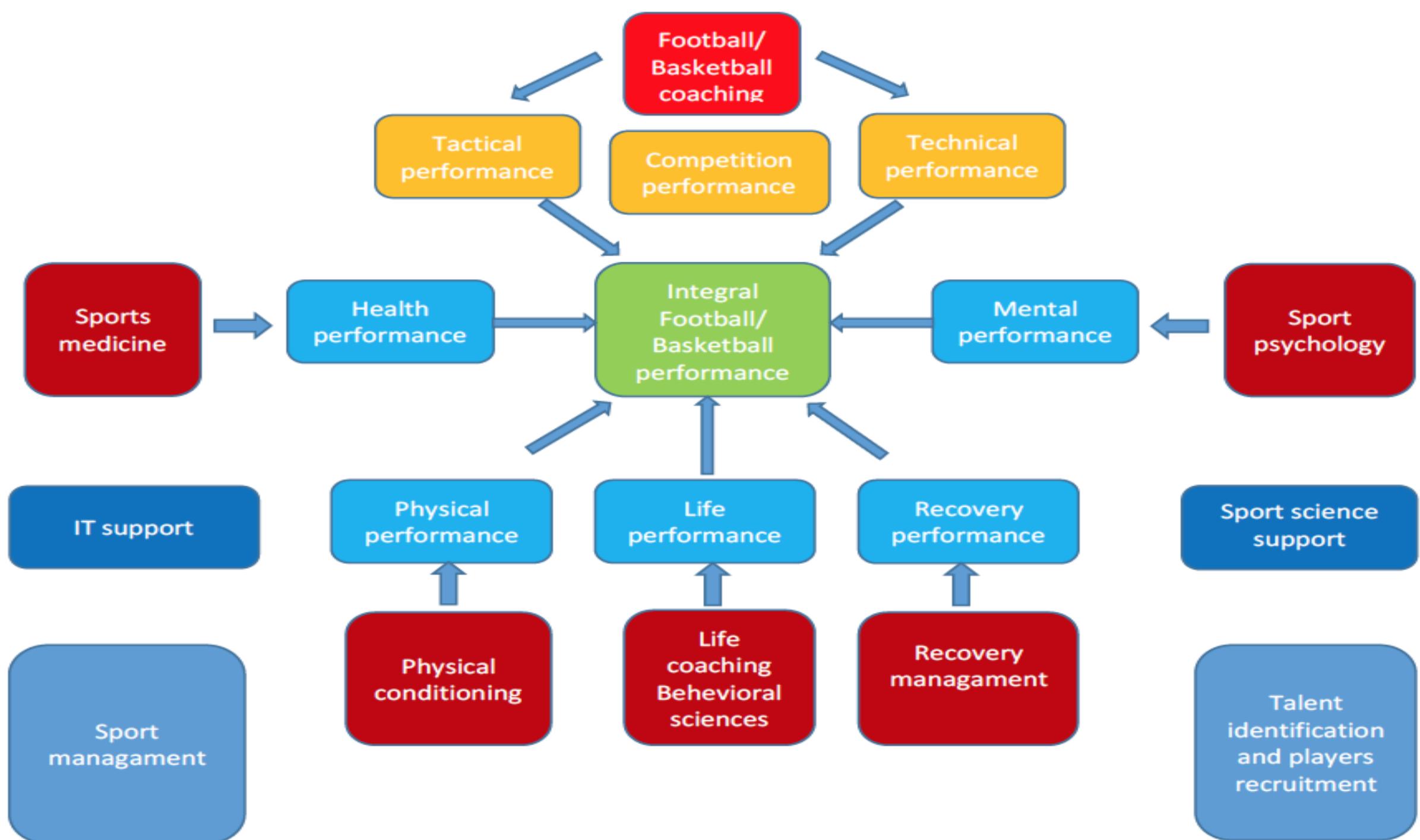
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# Three pillars...







Marco Aurelius

► Everything we hear is an opinion,  
not a fact. Everything we see is a  
perspective, not the truth.

# Football...

- ▶ Popular
- ▶ Atractive
- ▶ Visible
- ▶ Influental
- ▶ Complex
- ▶ Competitive
- ▶ Global

# Football...

- ▶ Conservative
- ▶ Controversal
- ▶ Compromised
- ▶ Violent
- ▶ Coruptive
- ▶ Close-minded
- ▶ Paradoxal

# Paradox...

...a self-contradictory statement  
that at first seems true...

Merriam Webster dictionary

# Football training and competition paradoxes...

- ▶ Pregame and halftime breaks
- ▶ Duration overload
- ▶ Training pitch size
- ▶ Rest intervals simulation

Football training and competition  
paradoxes...

WHY???

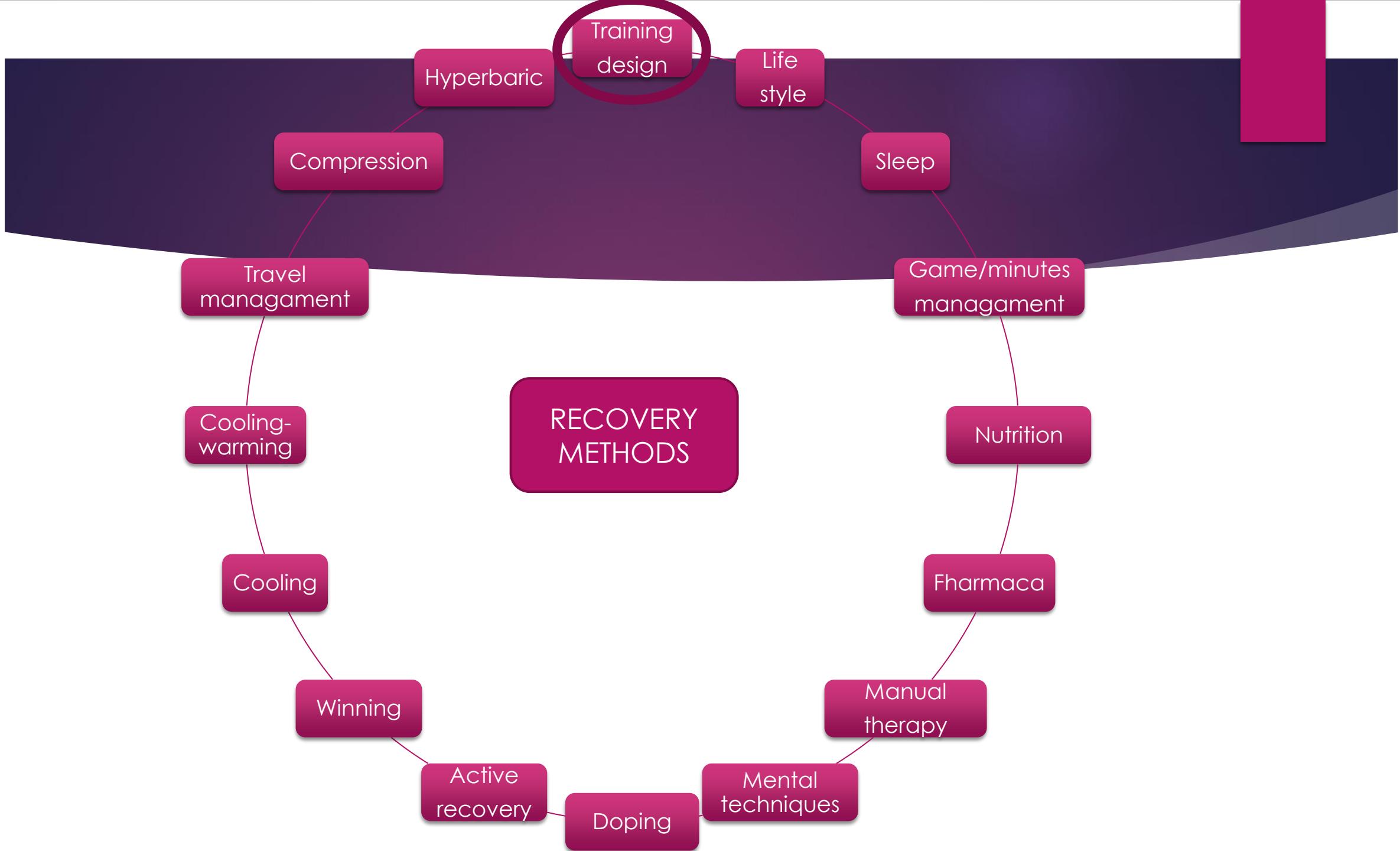
# Recovery

## RECOVERY

Acute  
(intra/inter-  
movement)

Short term  
(intra-training)

Long term  
(inter-training)



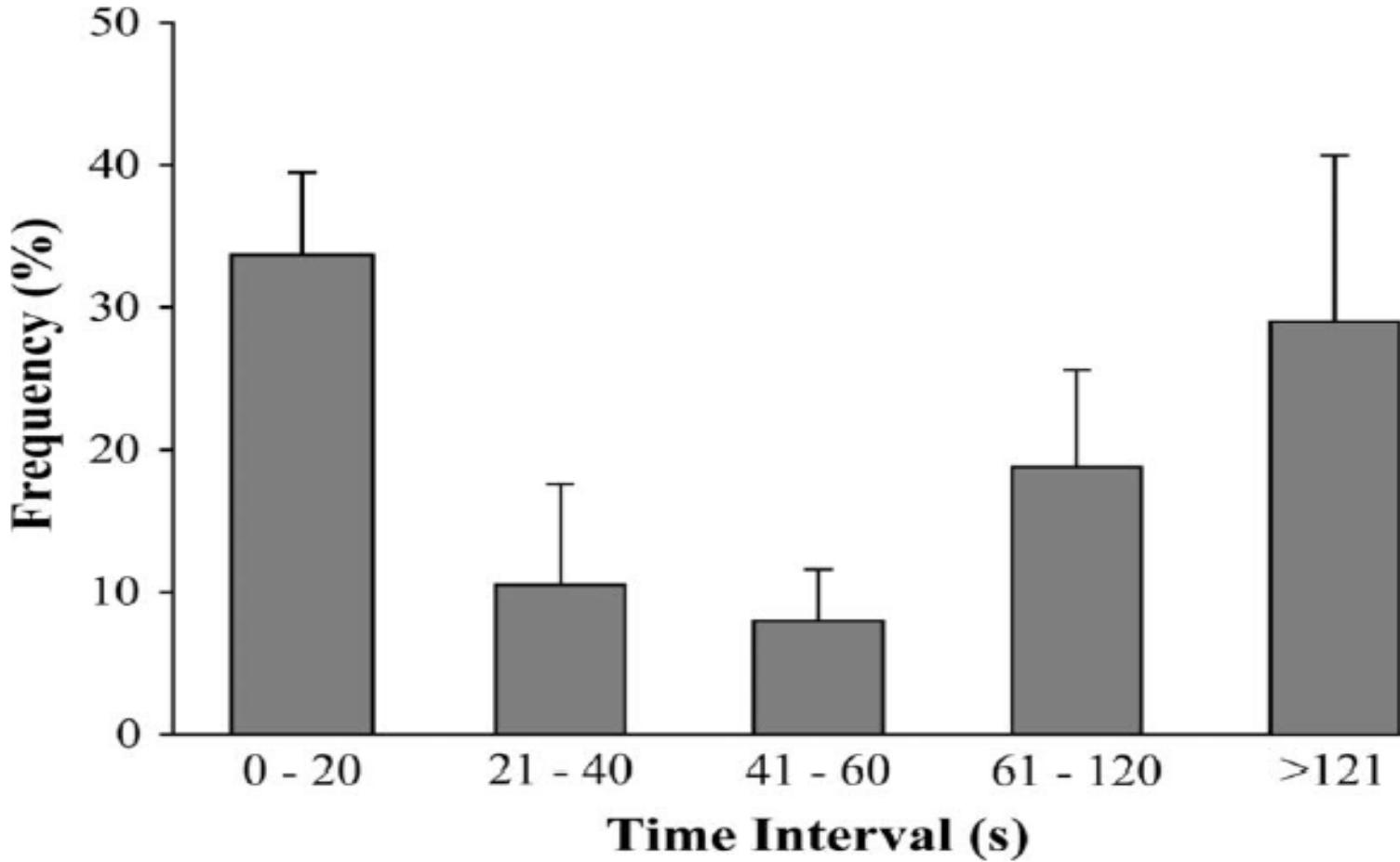
# Intra-training recovery

Inter-exercise  
recovery

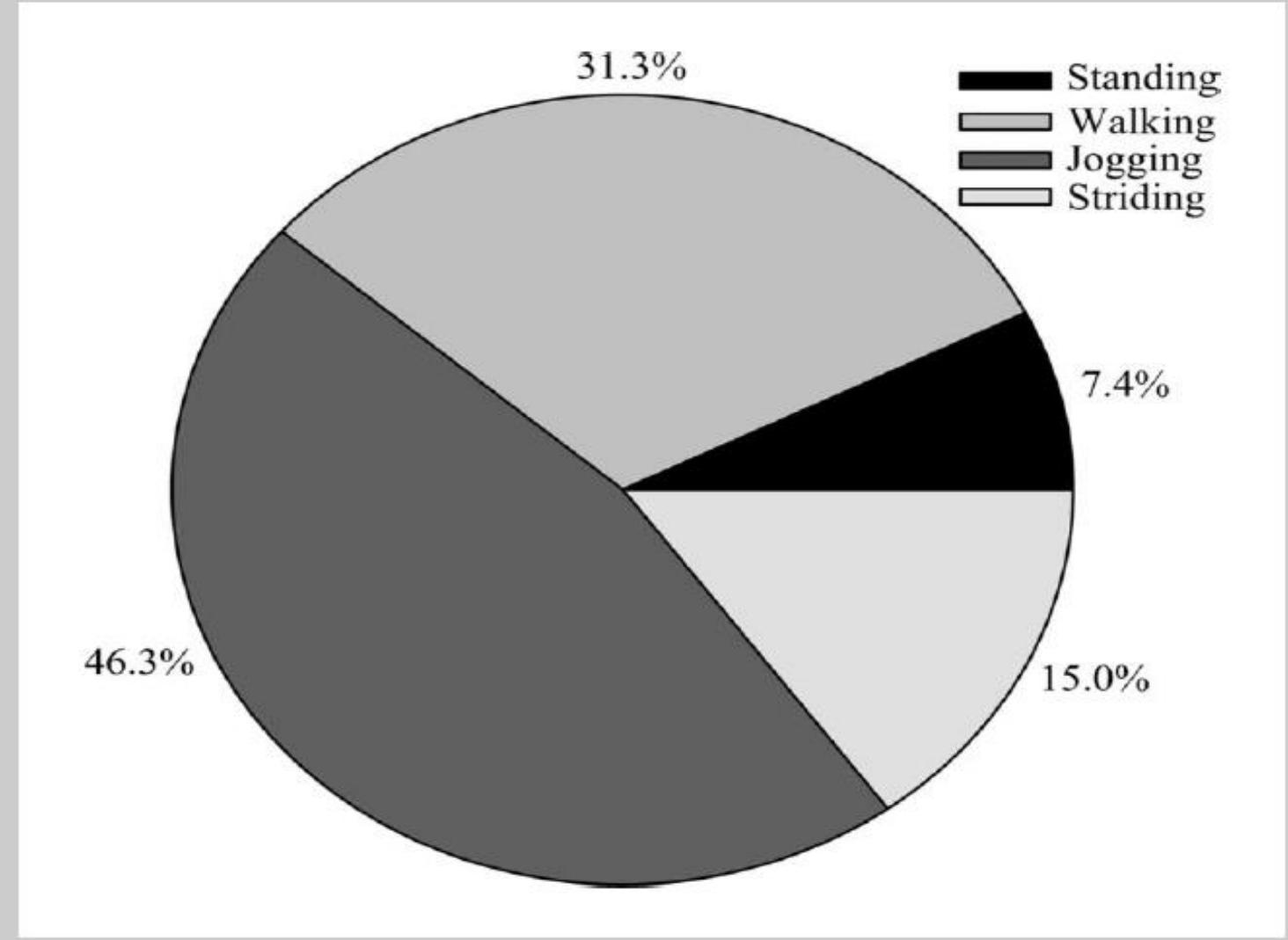
Intra-exercise  
recovery

# Football content (Stolen et al., Sports Medicine, 2005.)

VARIABLE	
%HRmax	80-90
Number of activities	1000-1400
High intensity activities occurrence	Each 90"
Sprint occurrence	Each 70"
Sprint (% of game)	0,5-3
Sprint (% of total distance)	1-11
Sprint (number)	10-20
Tackles	15
Headings	10



**Figure 4.** Frequency distribution of recovery times between sprints during a women's international soccer match. Data are mean  $\pm$  SD.



**Figure 5.** Recovery motions during repeated-sprint bouts performed during a women's international soccer match. Data are mean  $\pm SD$ .

**Duration [s]**

<b>Category</b>	<b>2006</b>	<b>2014</b>
Throw-in	(n=658) 10.2+5.4	(n=684) 11.5+7.3
Free kick	(n=628) 21.4+16.5	(n=493) 25.2+19.4
Free kick in the attacking zone	(n=37) 54.9+20.4	(n=32) 70.1+20.5
Goal kick	(n=292) 20.4+6.7	(n=288) 23.4+10.0
Corner kick	(n=135) 25.0+8.7	(n=158) 27.1+12.7
Kick-off	(n=26) 45.1+10.9	(n=27) 58.3+15.8
Penalty	(n=4) 70.3+18.4	(n=3) 105.3+38.1
Dropped ball	(n=16) 72.2+36.7	(n=7) 75.3+37.6

# Stoppages...

Game	Throw-in	Goal kick	Corner kick	Free kick	Free kick AZ	Subs
Official match	11''	23''	27''	25''	70''	45''
Training game	7-10''	15''	15''	10''	30-40''	15''
Small games	-	2-5''	-	2-5''	-	-
Middle game	-	2-5''	-	2-5''	-	-
Large game	-	2-5''	-	2-5''	-	-

# SMLG/SSG (small, middle, large sided games)

- ▶ Most common football training content
- ▶ 40-80% of "clear" football training
- ▶ Benefits:

Training programs over several weeks including SSGs have reported improvements in various match winning-related factors including technical proficiency, tactical awareness, speed, strength and endurance performance.<sup>6,8-10</sup>

Lacome et al., IJSPP, 2017.

# Games effective time (Casamichana and Castellano, JSS, 2010.)

GAME	% of effective time
Official	50-60
Small	67
Middle	75
Large	82

**Table VII.** Summary of different training regimens implemented in small-sided game studies with football players

Study	Sample size	Game design	Training prescription	Work : rest ratio	Regimen
Balsom et al. <sup>[30]</sup>	6	3 vs 3	6×3 min/2 min rest 15×70 s/20 s rest 36×30 s/15 s rest 36×30 s/30 s rest 1×30 min	1.5:1 3.5:1 2:1 1:1 –	Interval Interval Interval Interval Continuous
Owen et al. <sup>[34]</sup>	13	1 vs 1 → 5 vs 5	1×3 min/12 min rest	1:4	Interval
Aroso et al. <sup>[33]</sup>	14	2 vs 2 3 vs 3 4 vs 4	3×1.5 min/90 s rest 3×4 min/90 s rest 3×6 min/90 s rest	1:1 2.6:1 4:1	Interval Interval Interval
Jones and Drust <sup>[41]</sup>	–	4 vs 4 and 8 vs 8	1×10 min	–	Continuous
Rampinini et al. <sup>[32]</sup>	20	3 vs 3 → 5 vs 5	3×4 min/3 min rest	1.3:1	Interval
Kelly and Drust <sup>[36]</sup>	8	5 vs 5	4×4 min/2 min rest	2:1	Interval
Little and Williams <sup>[16]</sup>	28	2 vs 2 3 vs 3 4 vs 4 5 vs 5 6 vs 6 8 vs 8	4×2 min/2 min rest 4×3.5 min/90 s rest 4×4 min/2 min rest 4×6 min/90 s rest 3×8 min/90 s rest 4×8 min/90 s rest	1:1 2.3:1 2:1 4:1 5.3:1 5.3:1	Interval Interval Interval Interval Interval Interval
Dellal et al. <sup>[44]</sup>	10	1 vs 1 2 vs 2 4 vs 4+ GK 8 vs 8+ GK 8vs 8 10 vs 10 + GK	4×1.5 min/90 s rest 6×2.5 min/2.5 min rest 2×4 min/3 min rest 2×10 min/5 min rest 4×4 min/3 min rest 3×20 min/5 min rest	1:1 1:1 1.3:1 2:1 1.3:1 4:1	Interval Interval Interval Interval Interval Interval
Hill-Haas et al. <sup>[49]</sup>	16	2 vs 2; 4 v 4; 6 vs 6 2 vs 2; 4 vs 4; 6 vs 6	4×6 min/90 s passive rest 1×24 min	4:1 –	Interval Continuous
Fanchini et al. <sup>[50]</sup>	19	3 vs 3	3×2 min; 3×4 min; 3×6 min/4 min rest	1:2; 1:1; 1.5:1	Interval

GK= including goalkeepers; → indicates 1 vs 1, 2 vs 2, 3 vs 3, 4 vs 4 and 5 vs 5 small-sided games were used; – indicates no data.

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Fanchini et al. <sup>[50]</sup>	19	3 vs 3	3 × 2 min; 3 × 4 min; 3 × 6 min/4 min rest	1 : 2; 1 : 1; 1.5 : 1	Continuous Interval

GK = including goalkeepers; → indicates 1 vs 1, 2 vs 2, 3 vs 3, 4 vs 4 and 5 vs 5 small-sided games were used; – indicates no data.

Table 2: Between-small-sided games (SSGs) standardised differences in high-speed running and mechanical work intensity as a function of rolling average durations.

Distance > 14.4 km.h <sup>-1</sup> (m.min <sup>-1</sup> )	SSGs	4v4	6v6	8v8	10v10	Mechanical Work (a.u.min <sup>-1</sup> )
		90''	2'	3'		
	4v4		4v4 > 6v6 - [1-3]	4v4 > 8v8 - [1-4]	4v4 > 10v10 - [1-4, 10]	
	6v6	4v4 > 6v6 - [1]		6v6 > 8v8 - [10-15]	6v6 > 10v10 - [2-15]	
	8v8				8v8 > 10v10 - [6]	
	10v10	10v10 > 4v4 - [1-15]	10v10 > 6v6 - [1-15]	10v10 > 8v8 - [1-15]		

Only effect sizes > 0.6 with likely chances (>75%) that the differences are true are reported. [x] : Rolling average duration.

# HIT bible

Sports Med (2013) 43:313–338  
DOI 10.1007/s40279-013-0029-x

REVIEW ARTICLE

## High-Intensity Interval Training, Solutions to the Programming Puzzle

### Part I: Cardiopulmonary Emphasis

Martin Buchheit · Paul B. Laursen

Sports Med  
DOI 10.1007/s40279-013-0066-5

REVIEW ARTICLE

## High-Intensity Interval Training, Solutions to the Programming Puzzle

### Part II: Anaerobic Energy, Neuromuscular Load and Practical Applications

Martin Buchheit · Paul B. Laursen

Table 1 Recommendations for the design of run-based high-intensity interval training protocols for optimizing time at maximal oxygen uptake

Format	Work duration	Work intensity <sup>a</sup>	Modality	Relief duration	Relief intensity	Reps and series <sup>b</sup>	Between-set recovery		Expected T@ $\dot{V}O_{2\max}$	Acute demands <sup>c</sup>
							Duration	Intensity		
HIT with long intervals	>2-3 min <sup>d</sup>	$\geq 95\% \dot{V}O_{2\max}$	Sport specific	<2 min	Passive	6-10 x 2 min 5-8 x 3 min 4-6 x 4 min	$\geq 4-5$ min	$\leq 60-70\% \dot{V}O_{2\max}$ <sup>b</sup> $\leq 60-70\% \dot{V}O_{2\max}$ $\leq 60-70\% \dot{V}O_{2\max}$ <sup>b</sup>	>10 min	Central ++++
				$\geq 4-5$ min	$\leq 60-70\% \dot{V}O_{2\max}$ <sup>b</sup>					
HIT with short intervals	$\geq 15$ s <sup>d,e</sup>	100-120 % $\dot{V}O_{2\max}$ (85-105 % $V_{IFT}$ )	Sport specific	<15 s	Passive	2-3 x $\geq 8$ -min series	$\geq 4-5$ min	$\leq 60-70\% \dot{V}O_{2\max}$ <sup>b</sup>	>10 min	Central +++
				$\geq 15$ s	$\leq 60-70\% \dot{V}O_{2\max}$ (45-55 % $V_{IFT}$ )					
RST	>4 s (>30 m or 2 x 15 m)	All-out	COD jumps explosive efforts	<20 s	$\approx 55\% \dot{V}O_{2\max}$ / 40 % $V_{IFT}$	2-3 x $\geq 8$ -min series	$\geq 6$ min	$\leq 60-70\% \dot{V}O_{2\max}$ <sup>b</sup>	0-3 min	Central + Peripheral +++
SIT	>20 s	All-out	Sport specific	$\geq 2$ min	Passive	6-10	$\geq 6$ min	$\leq 60-70\% \dot{V}O_{2\max}$ <sup>b</sup>	0-1 min	Peripheral ++++
Game-based training	>2-3 min	Self-selected RPE >7	Sport specific <sup>f</sup>	<2 min	Passive					

**Table 3** Recommendations for the design of run-based high-intensity interval training protocols in reference to acute neuromuscular performance and potential injury risk

Format	Work duration	Work intensity <sup>a</sup>	Modality	Ground surface <sup>b</sup>	Relief duration <sup>c</sup>	Reef intensity <sup>a</sup>	Acute change in muscular performance <sup>c</sup>	Injury risk level <sup>d</sup>
Game-based training	>2–3 min	Self-selected RPE >7	Sport specific	Sport specific	≤2 min	Passive 55 % $\dot{V}VO_{2\max}$ (40 % V <sub>IFT</sub> )	SSG format-dependent	Traumatic ++ (contacts, joint sprain) overuse +

**Table 2** Recommendations for the design of run-based high-intensity interval training protocols with respect to blood lactate accumulation

Format	Work duration	Work intensity <sup>a</sup>	Modality	Relief duration	Relief intensity <sup>a</sup>	Expected initial rate of blood lactate accumulation (mmol/L/5 min)
Game-based training	3–4 min	Self-selected RPE >7	Sport specific	≤2 min ≥4–5 min	Passive 55 % $\dot{V}O_{2\max}$ (40 % $V_{IFT}$ )	≤5

**Table 4**  
**Examples of small-sided game formats**

Number of players	Pitch dimensions, m	Timings	Notes
3v3–4v4	25 × 20–30 × 25	2 × 6 × 1 min (1.5-min rest)–3 × 6 × 2 min (1-min rest)	Limited tactical component
			High number of actions per player
			High intensity
			Increased acceleration/deceleration and change of direction
5v5–7v7	40 × 30–60 × 35	4 × 4 min (2-min rest)–5 × 8 min (2-min rest)	Moderate tactical component
			Moderate to high number of actions
			Moderate to high intensity
			Accelerations/decelerations and high speed running
8v8–11v11	70 × 40–90 × 45	3 × 12 min (2-min rest)–4 × 15 min (2-min rest)	High tactical component
			Low number of actions per player
			Lower intensity (increased recovery between actions)
			Increased high speed running
			Larger aerobic emphasis

**Table 4**  
**Examples of small-sided game formats**

Number of players	Pitch dimensions, m	Timings	Notes
3v3–4v4	25 × 15	1'	Small component
		2'	High number of actions per player
		2'	Acceleration/deceleration and direction
5v5–7v7	40 × 20	1'	Technical component
		2'	High number of actions
		2'	High intensity
		2'	Decelerations and high running
8v8–11v11	70 × 40	1'	Large component
		2'	High number of actions per player
		2'	Recovery (increased recovery between actions)
			Increased high speed running
			Larger aerobic emphasis

Generally  
We can not mistake with  
2'

## SMLG inter-exercise and intra-exercises rest intervals

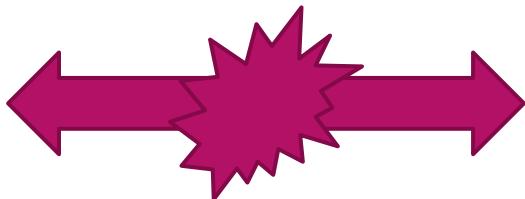
- ▶ Do not simulate real game rest intervals

# SMLG Inter/Intra rest intervals paradox...

- ▶ Inter exercise rest intervals mainly **longer** than real game rest intervals
- ▶ Intra exercises rest intervals mainly **shorter** than real game rest intervals

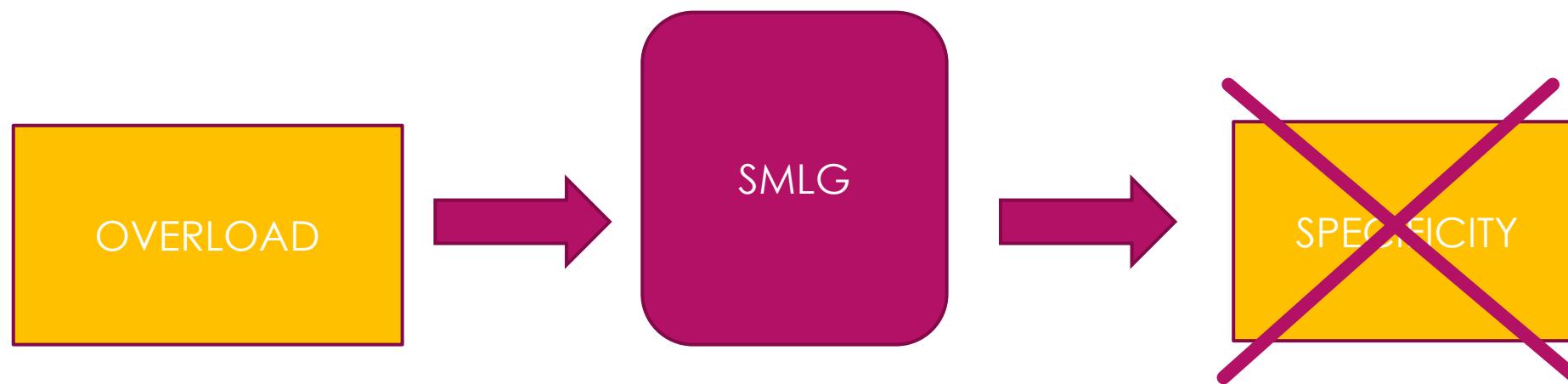
# Evergreen principles confrontation...

OVERLOAD



SPECIFICITY

# Evergreen principles confrontation...



# Evergreen principles balance...

OVERLOAD

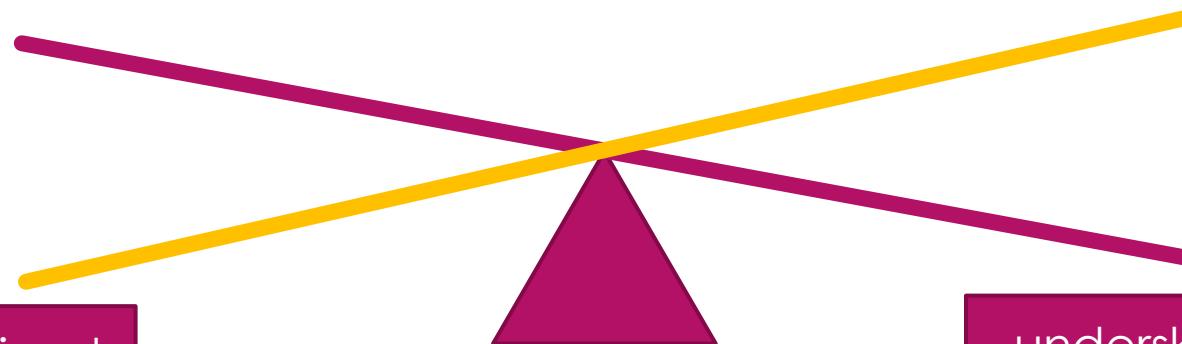
overtrained

SPECIFICITY

overskilled

undertrained

underskilled



# Evergreen principles balance...

OVERLOAD

SPECIFICITY

## VARIABILITY

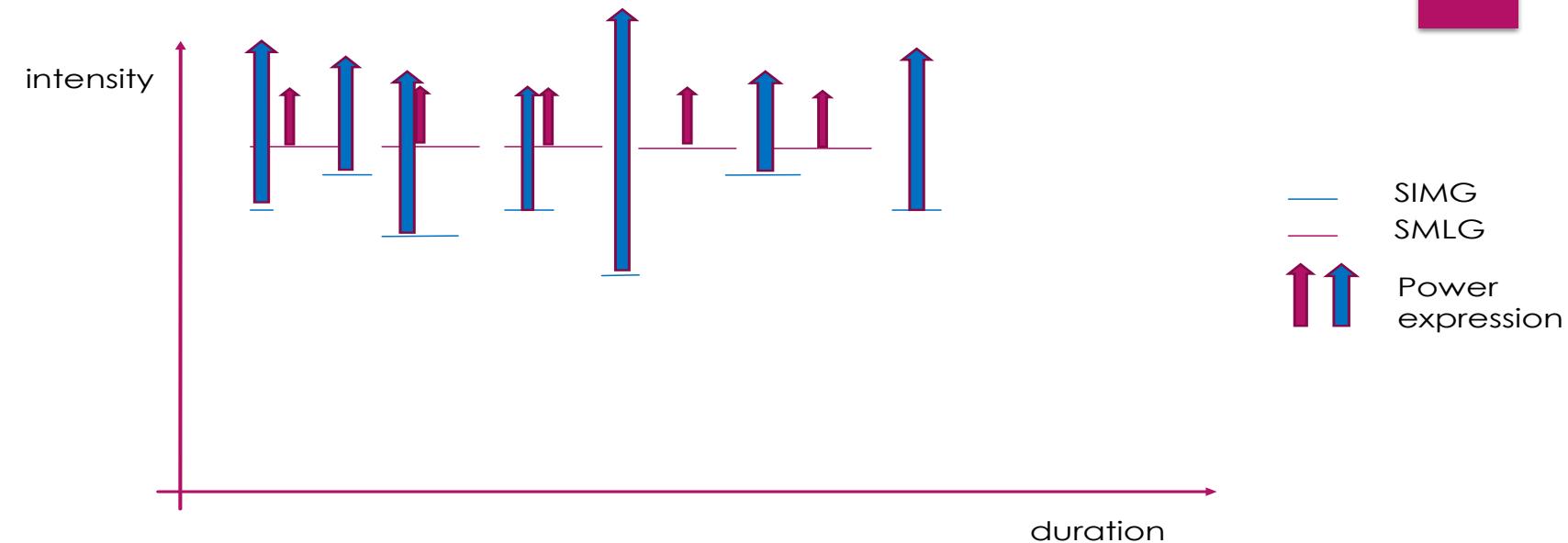
# Main issues...

- ▶ Can we train/improve intra-game recovery?
- ▶ How?
  - ▶ Generic training (whole bio-energetical continuum)
  - ▶ Specific intensification (SMLG)
  - ▶ Real games (official games, training games, simulation games)

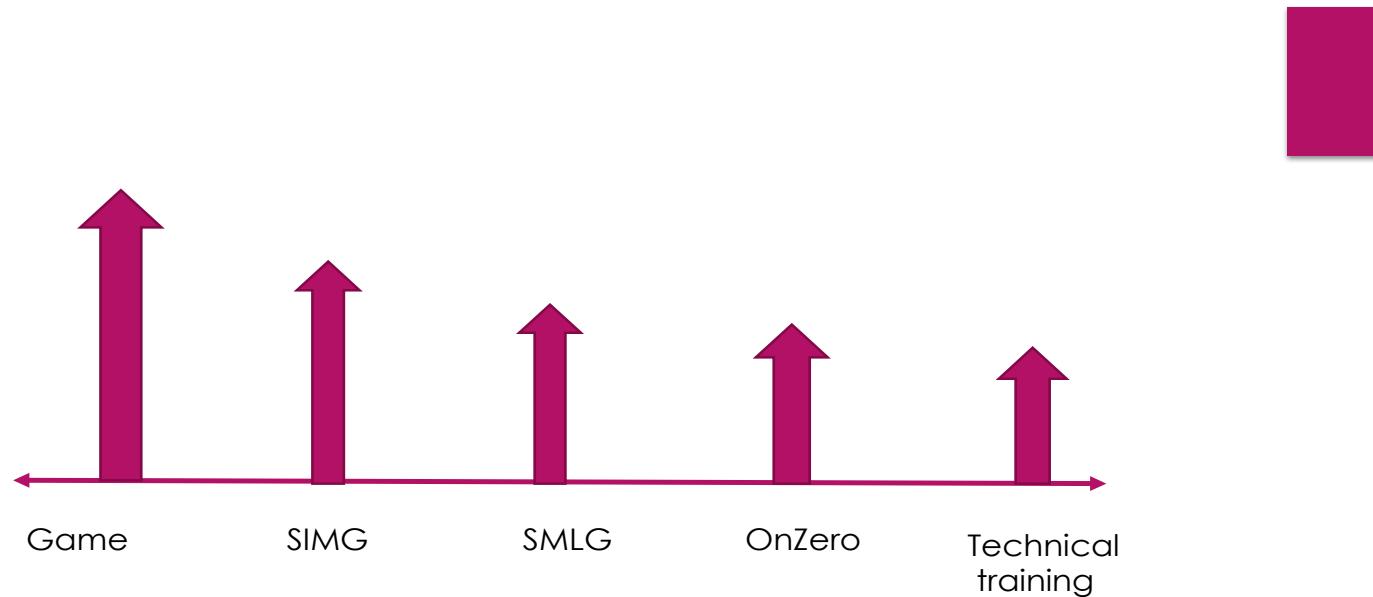
# Simulation games (SIMG)

- ▶ Game simulation (part of pitch, part of game, special situations)
- ▶ Competitive
- ▶ Official rules game
- ▶ **Intra-exercises rest intervals close to real game (10-75'')**
- ▶ Exercise (set) duration 5-30'
- ▶ Intensity – accent on "stop-sprint" principle
- ▶ Using rest intervals for corrections
- ▶ Fixed or random rest interval frequency
- ▶ Mostly large sided games

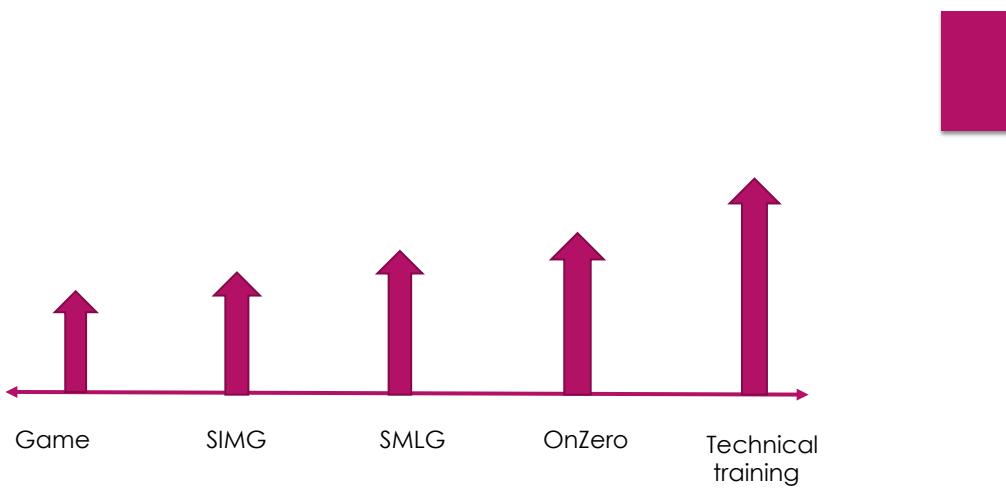
# Power expression



# Technical-tactical content (team training)



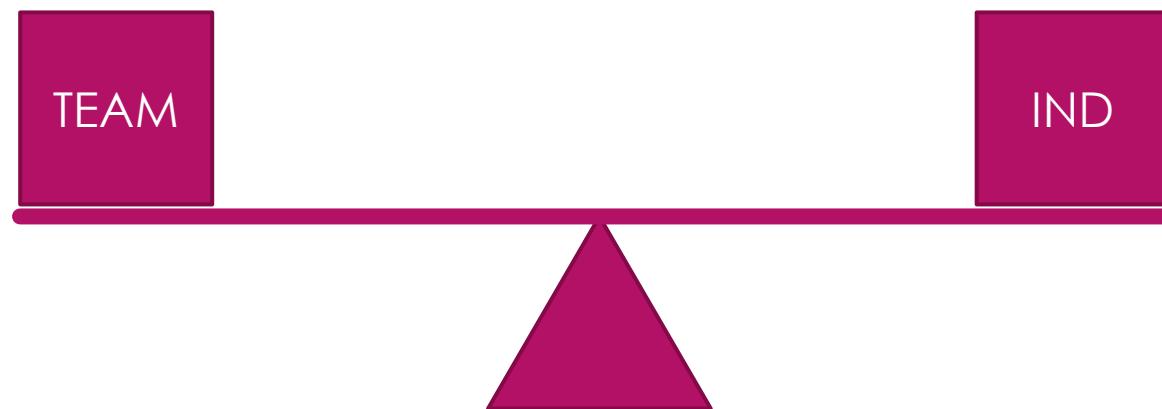
# Technical-tactical content (youth)



# Football training content – Evergreen approach



# Team/individual needs balance...



# Recovery

## RECOVERY

Acute  
(intra/inter-movement)

Short term  
(intra-training)

Long term  
(inter-training)

# Who will benefit in future

- ▶ **Those who will care more about:**
  - ▶ Individual players needs (Physical, Technical, Tactical, Mental...)
  - ▶ Higher volume of training (more repetitions)
  - ▶ Technical and tactical details
  - ▶ Game simulation

# People in boxes...



# Shepherd and sheeps



# Steve Jobs about creativity...

► **Creativity is just connecting things.** When you ask creative people how they did something, they feel a little guilty because they didn't really do it, they just saw something. It seemed obvious to them after a while. **That's because they were able to connect experiences they've had and synthesize new things.** And the reason they were able to do that was that they've had more experiences or they have thought more about their experiences than other people.

# The ten fundamental laws of winning in high performance sport are (Wayne Goldsmith):

- ▶ To be **different**;
- ▶ To be **unique**;
- ▶ To do things **first**;
- ▶ To be **more creative and more innovative** than your competition;
- ▶ To **take risks**;
- ▶ To **create and sustain a culture which is focused on winning** – on being the best;
- ▶ To **fight hard and compete with total commitment**;
- ▶ To not accept anything but the best from **everyone** involved in your team: athletes, coaches, staff, management, Board – everyone must be committed to winning;
- ▶ To see winning as not just a destination **but an attitude that pervades every aspect of every thought and action** within your team every day;
- ▶ To **not compromise on the consistent implementation** of the first nine laws.