Science & Cycling
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Case study: Psycho-physiological parameters and pacing strategy associated with a 6 days 6 nights ultra-endurance event on bike

A ABEL[1], F GRAPPE[2]

[1] PhD Student in Sports Physiology, C3S, EA4660, Health Sport Department, University of Franche Comté / Coach of the continental Cycling Team Wallonie Bruxelles

[2] PhD, C3S, E44660, Health Sport Department, University of Franche Comté / Coach of the Professional cycling Team FDJ.fr

6 days 6 nights ultra-endurance event on Home Trainer fixed gear bicycle

➔ **2700km travelled** => World Record!!!

A holistic approach was adopted encompassing physical, biological and psychological factors

Palmares

➔ June 2011 (Antibes, France): 6 Day event on treadmill => 814,3 km (World Record)

➔ December 2012 (Artaix, France) => 816 km (New World Record)

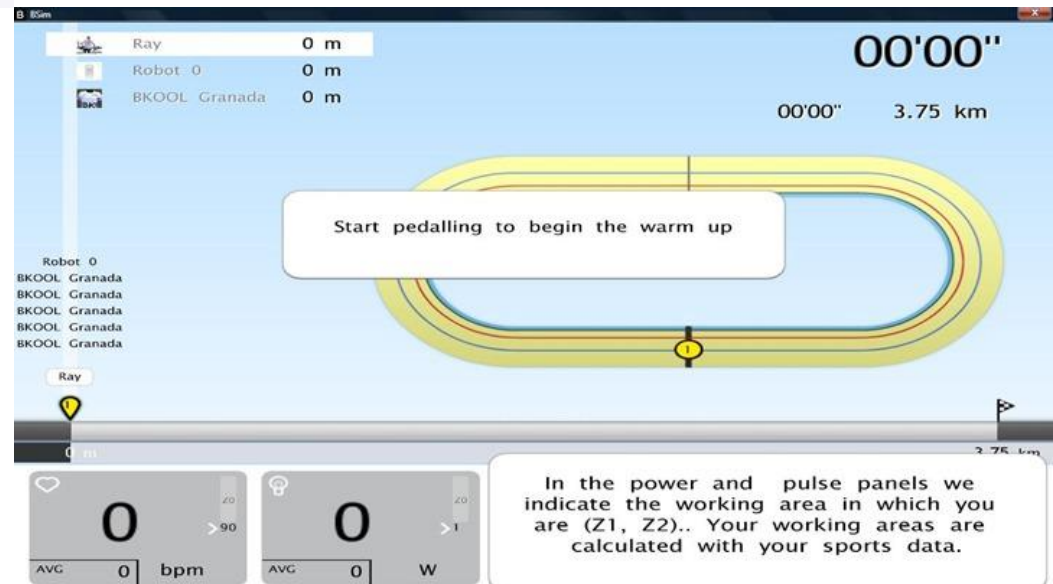➔ May 2012: Cité des Sciences, Paris, France => 822,3 km (Guiness World Record)

Method

HT coonected to software Bkool® permitting simulation of a velodrome event

The subject could watch himself riding on a virtual velodrome and he could determine the number of laps he wished to ride
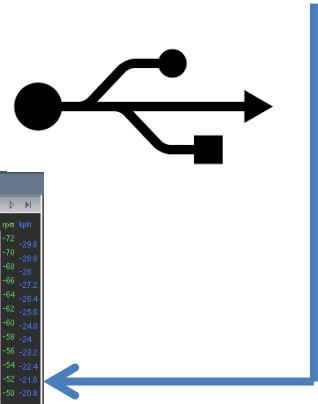
Power Output (PO, W), **Pedalling Cadence** (PC, rpm)
Heart Rate (HR, bpm), **Velocity** (V, km.h-1)

Power Tap®

Garmin Edge 510®
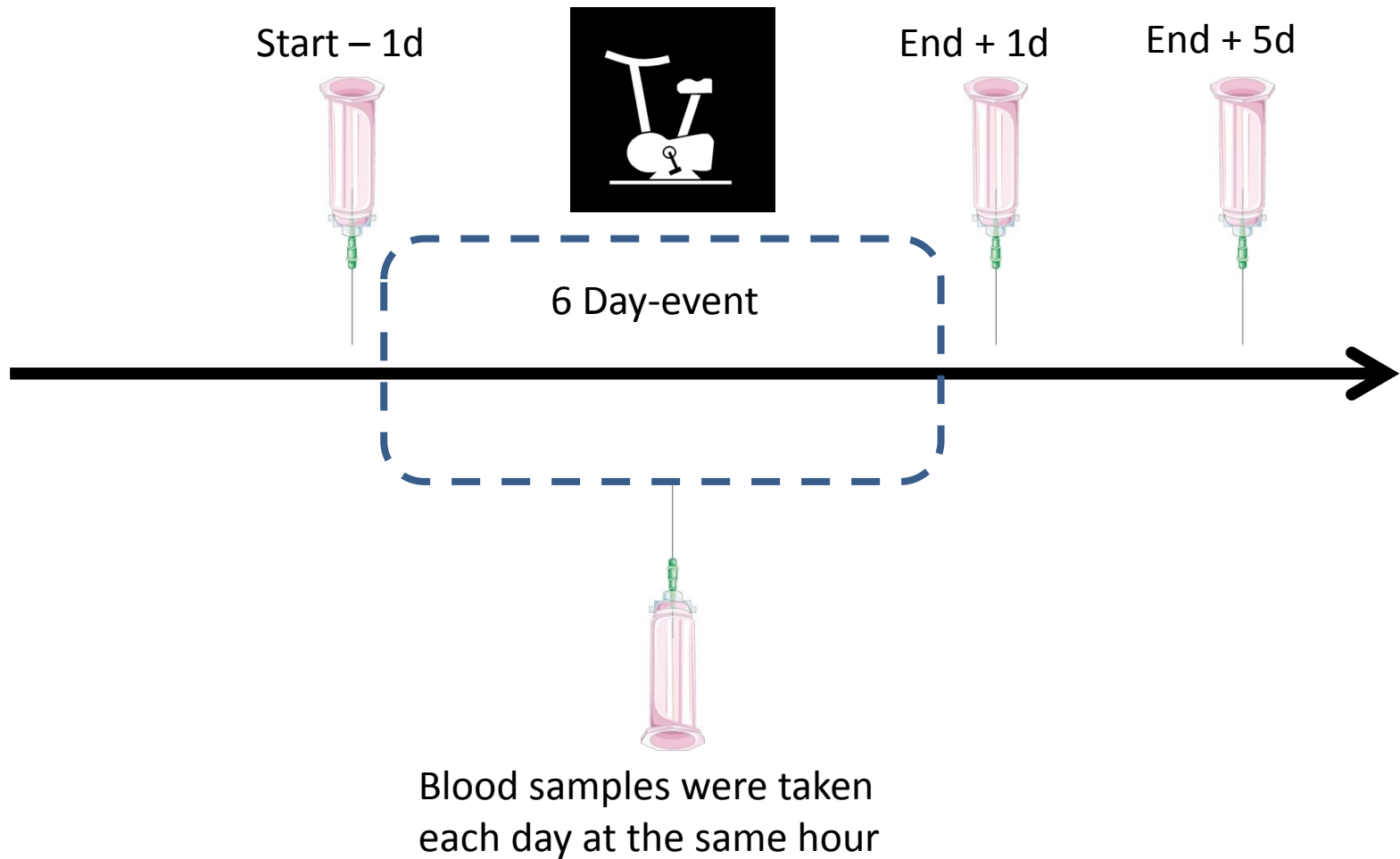
*Training Peaks
WKO+® software*

AFFECTIVE LOAD

RPE

10	Maximal
9	
8	
7	Very Strong
6	
5	Strong
4	
3	Moderate
2,5	
2	Weak
1,5	
1	Very weak
0,7	
0,5	Extremely weak
0,3	
0	Nothing at all

PLEASURE

10	Maximal
9	
8	
7	Very Strong
6	
5	Strong
4	
3	Moderate
2,5	
2	Weak
1,5	
1	Very weak
0,7	
0,5	Extremely weak
0,3	
0	Nothing at all

Performance +++

Performance +

Performance ---

F. Grappe, 2012

Biological data

Start – 1d

6 Day-event

End + 1d

End + 5d

Blood samples were taken
each day at the same hour

Biological markers

➔ <u>Muscular stress</u>

Albumin, C-Reactive protein

➔ <u>Heart stress</u>

Pro-BNP

➔ <u>Hormones</u>

Cortisol, testosterone, catecholamine
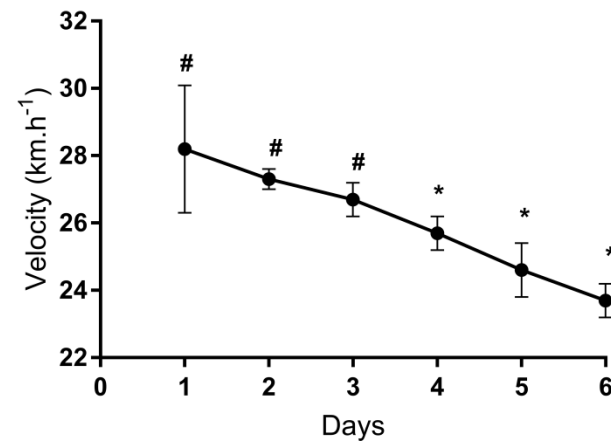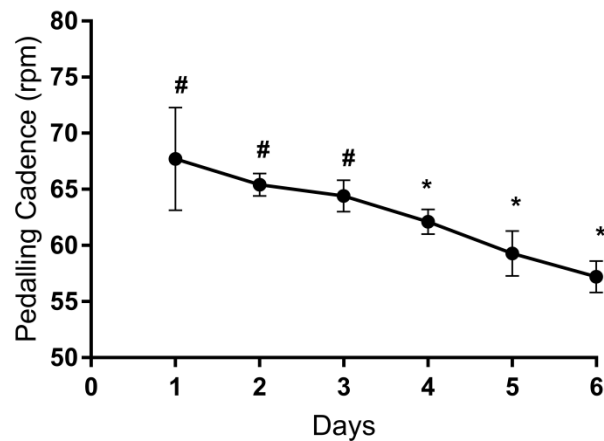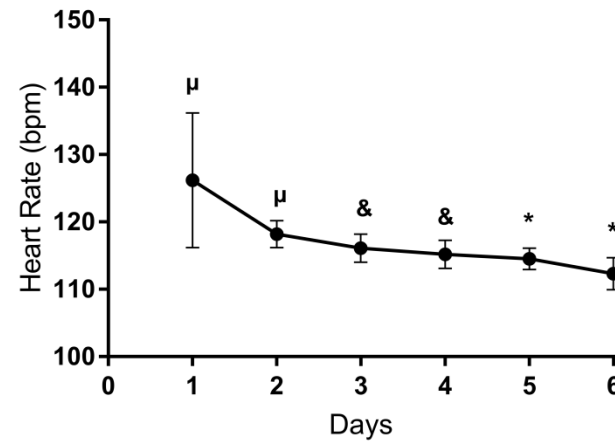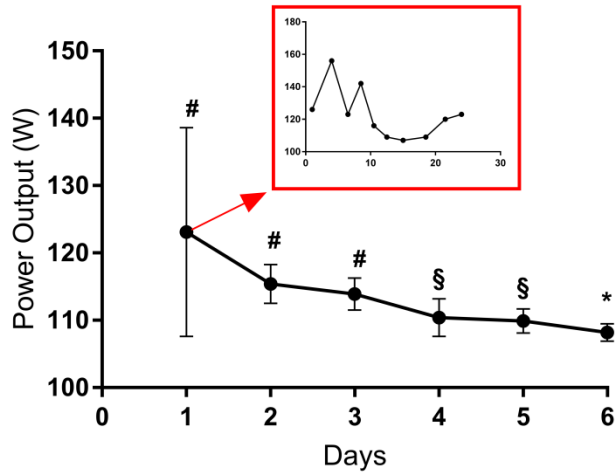
Energy expenditure

Food and Fluid intake were logged (Nutrilog© software) and the subject was weighed every day on a medical scale

Sleeping strategy

Phases of activity and rest were measured using an actimeter (Actiwatch®)

Results / Discussion

Evolution of power output (A), heart rate (B), pedaling cadence (C) and velocity (D) over the six days of the event (* P < 0.05 vs. all the other days (P < 0.05); # P < 0.05 vs. d4, d5 and d6; μ P < 0.05 vs. d3, d4, d5 and d6; & P<0.05 vs. d1, d2, d5 and d6. The first graph details variations of PO during the first 24 hours
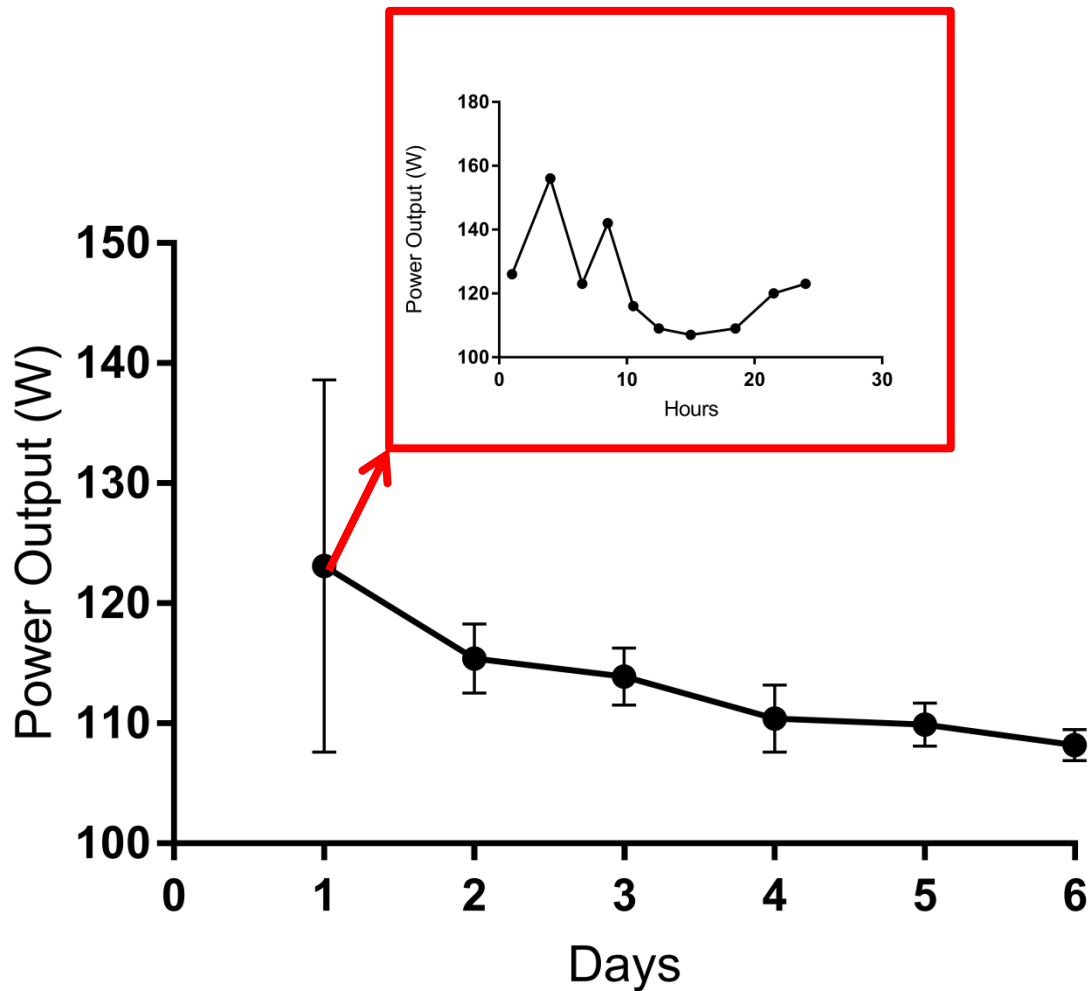
✓ PO ↘ 12% between the first and the last day

✓ The first day the subject tried to find his optimal pace to enable him to reach his goal while avoiding premature prefatigue

Age (yr)	47
Height (m)	1,75
Weight (kg)	71
Power Output at LT (W/kg)	4,5
Maximal Power Output (W/kg)	5,2
VO$_{2peak}$ (ml/min/kg)	72
Maximal HR (bpm)	174

Physiological data were comparable with those reported for well-trained but non-elite cyclists

Mean PO throughout this event: **1,6 ± 0,06 W/kg**

$\Rightarrow$ Mean PO of flat stages of major cycling tours (2,5 – 3,5 W/kg)
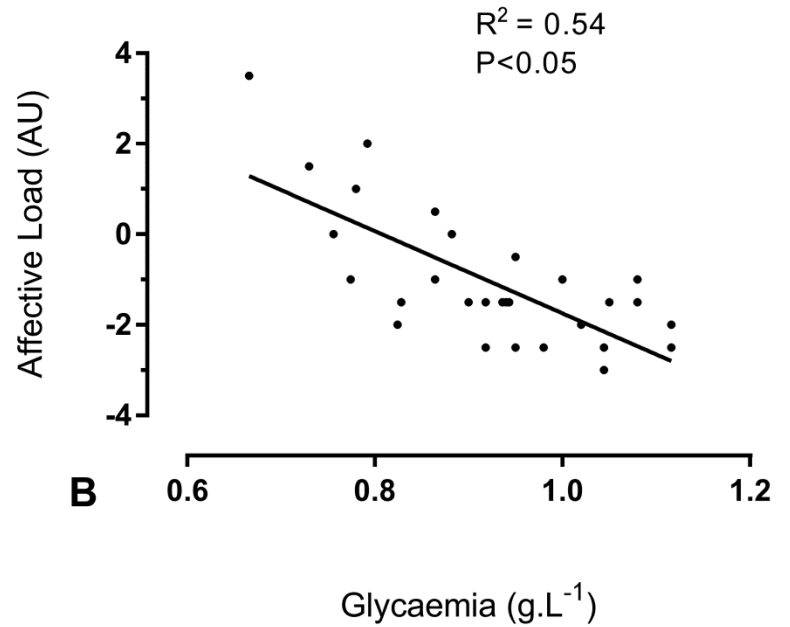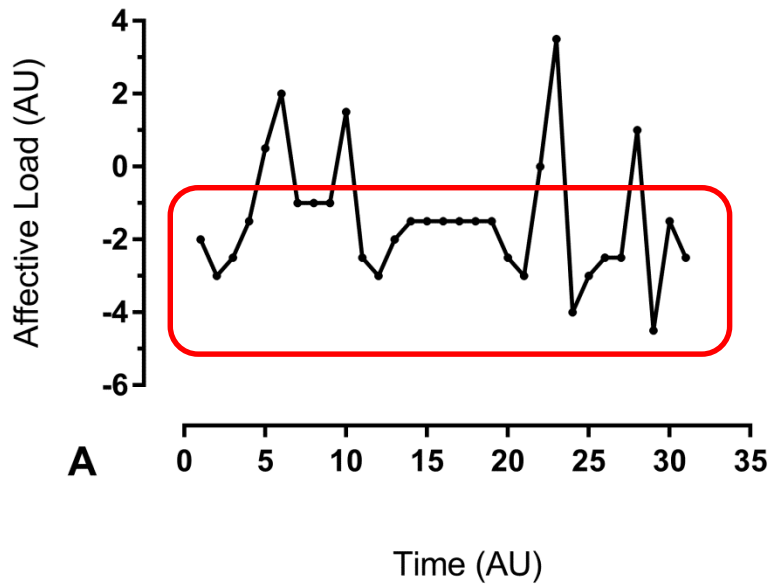
Young ultra-endurance athletes were slower than older athletes (Knecthtle et al. 2015)
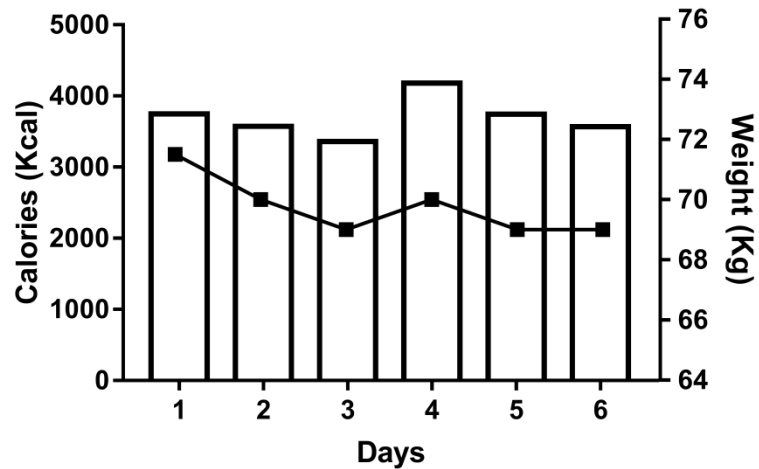
The athlete consumed 3680 ± 280 kcal per day

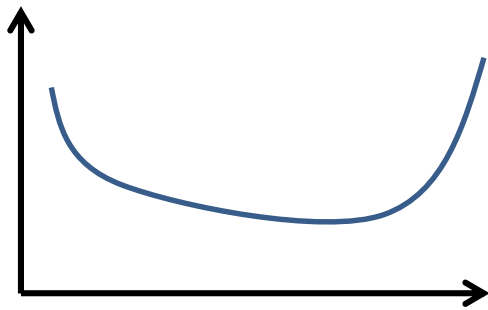**Tour de France: 6000-7500 kcal** (Jeukandrup *et al.*, 2000)

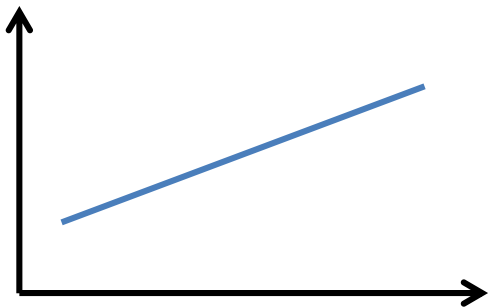**RAAM: 7500-9000 kcal** (Linderman *et al.*, 2011)

When AL increased significantly, the response of the subject was to reduce it quickly, apparently seeking a low AL in order to maintain an optimal level of PO
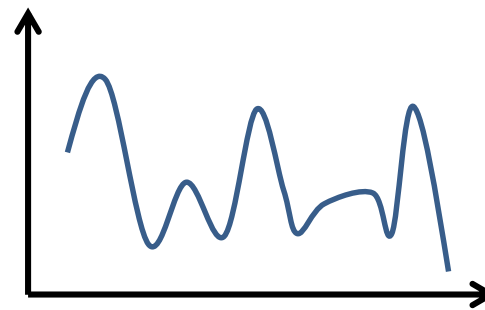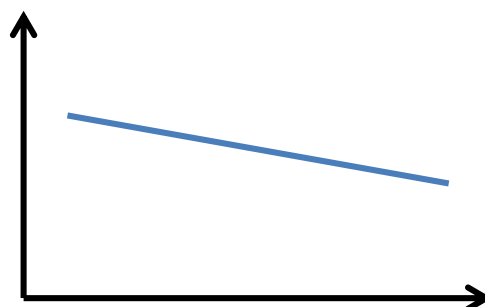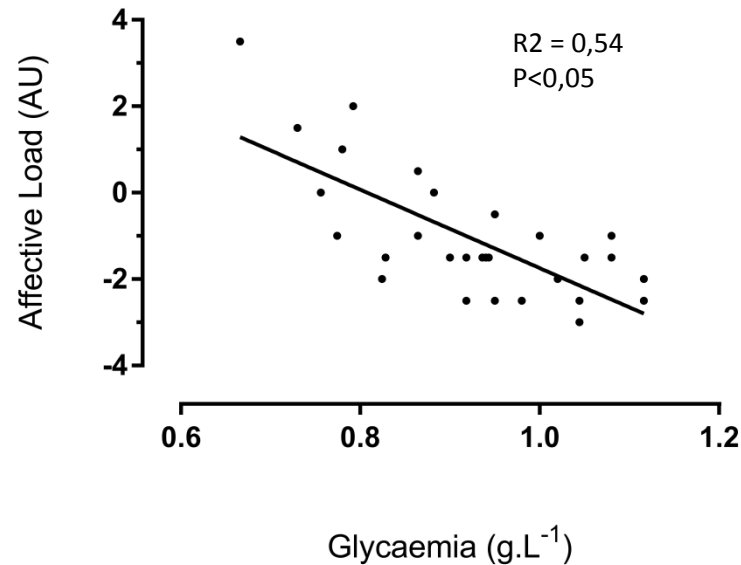
| Cycling TT event	Ultra-endurance event

PO

AL

AL

PO

We identified a **moderate correlation between AL and Glycaemia** (r = 0,68; P<0,05)

=> Intentional efforts to regulate emotions and maintain self-control use physiological ressources such as glucose (Beedie and Lane, 2011).

In the present study **the subject adopted a range of mental strategies**

➔ Motivational self-talk => Enhance performance and delay exhaution (Aitcchinson et al, 2013)

➔ Dissociative psychological strategies (such as autohypnosis) => to avoid thinking about the difficulty of the exercise (Davidson et al. 2003)

➔ Attentional strategy (as relaxation) => improve movement economy (Schrücker et al. 2016)
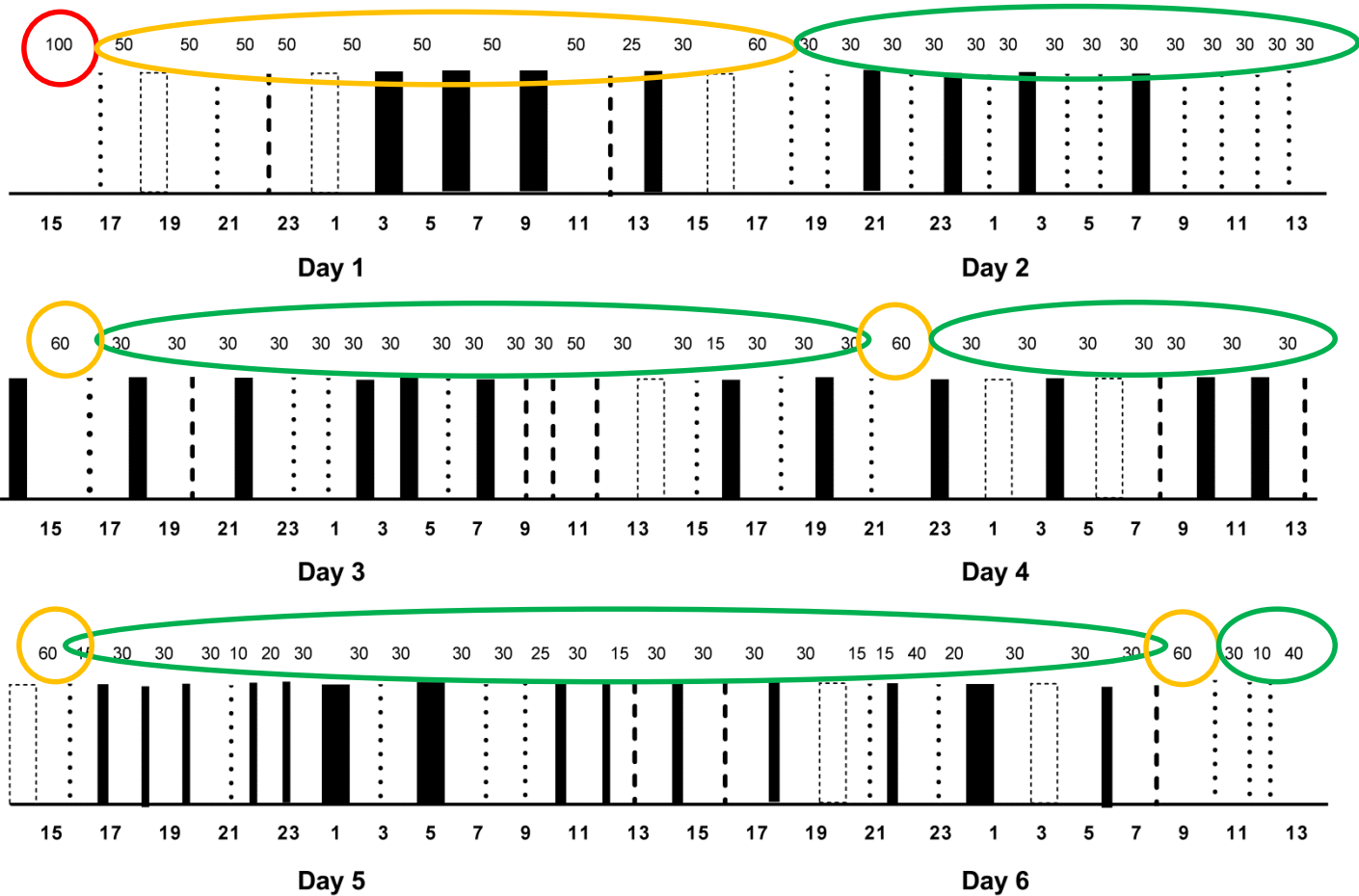
➔ First day: The athlete selected 100 km and 50 km sessions

➔ After one day the intermediate goals were set at 30 km

Entire Event

Block 1 **Block 2** **Block 3** **Block 4**

- ✓ PO difficult to manage

- ✓ It is a jump into the unknown

- ✓ Motivation ---

**Mentally chunck the entire event into blocks of shorter duration**

$\Rightarrow$ The subject can mobolize optimal ressources for each session

$\Rightarrow$ Motivation ++

Biological Data

	CRP	Albumine	pro BNP	Cortisol	Testostérone	Adrenaline	Noradrenaline	Dopamine
Normal Range	mg/L	g/L	ng/L	nmol/L	ng/ml	nmol/L	ng/L	nmol/L
	<10	35-50	<125	171-536	2,5 - 9	<1	<675	<1
baseline	<5	42	42	350	6,4	<0,5	476	<0,5
h + 24	19*	45	222 *	830 *	1,4 *	<0,5	1226 *	<0,5
h + 48	21*	43	369 *	504	1,8 *	<0,5	1189 *	<0,5
h + 72	15*	38	462 *	275	3,1	<0,5	660 *	<0,5
h + 96	11*	37	688 *	339	2,9	<0,5	1575 *	<0,5
h + 120	9	34	822 *	251	3,7	<0,5	1249 *	<0,5
h + 144	<5	37	449 *	336	4,5	<0,5	755 *	<0,5
end + 1d	<5	37	86	262	5,6	0,5	1036 *	<0,5
end + 5d	<5	36	14	187	7,9	<0,5	362	<0,5

✓ Albumin constant => abscence of important protein catabolism or dehydration

✓ CRP, Pro-BNP have been shown to be elevated following different types of endurance exercise to levels well beyond those measured in this study

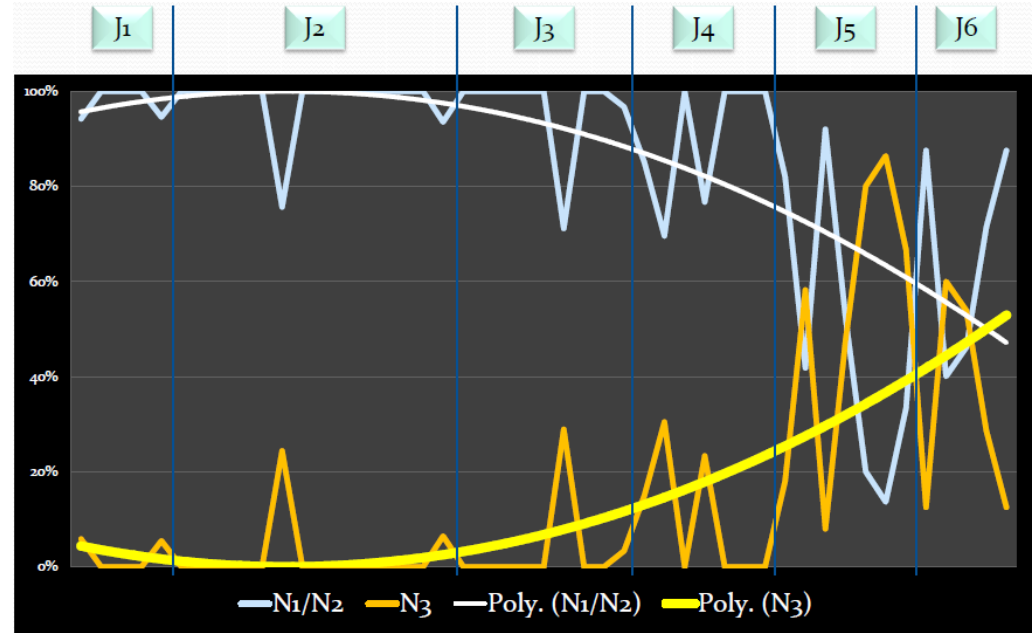✓ High level of noradrenaline => could be explained by significant cerebral activity

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Sleeping Strategy
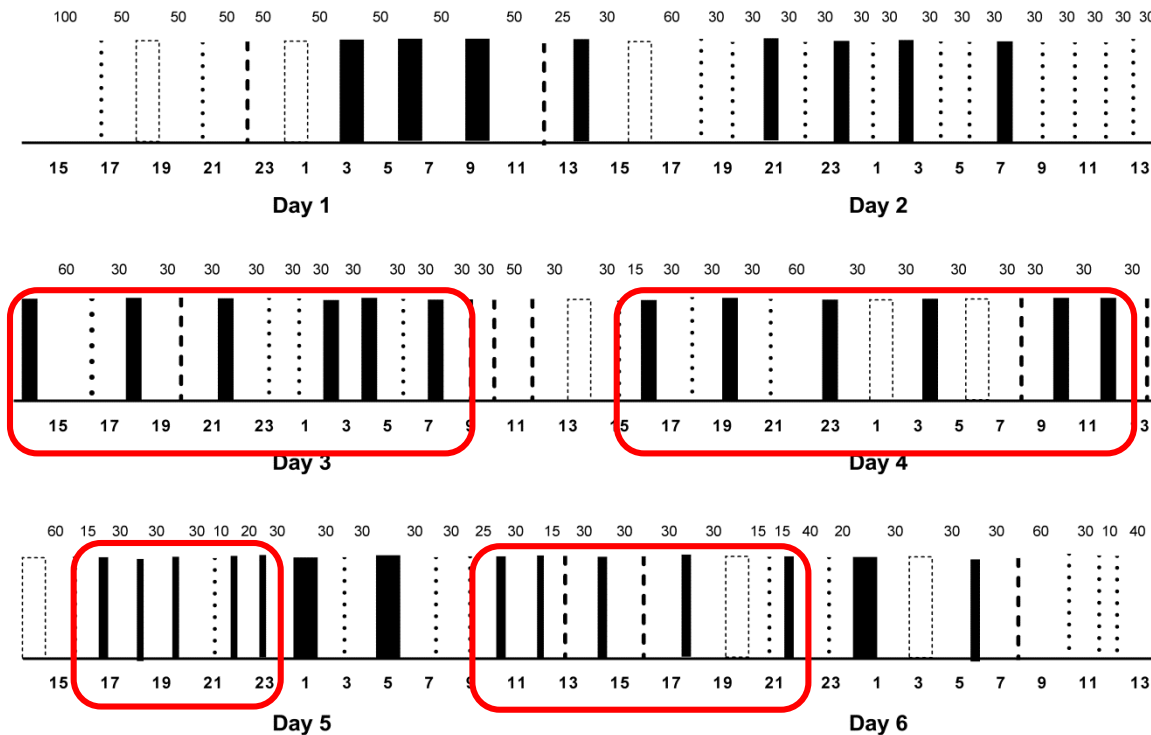
- ✓ **4 to 9 naps per day**

- ✓ The subject rested on average **126 ± 20 min** per day

Since the third day, the sleep became more plyphasic
=> Naps shorter but more frequent

6 days 6 nights event on treadmill (Paris, 2012)

➔ From the third day, sleep became more polyphasic and the time spent in stage 3 (deep sleep) was more important (Mullens, 2011)

=> As stage 3 is associated with physical recovery, the sleeping pattern could be modified to favour a more physically restfull sleep

Conclusion

✓ Positive pacing strategy => optimal for ultra-endurance events

✓ Importance to manage AL for sustaining the greatest level of PO

✓ The sleeping strategy adopted by our subject seemed effiscient because it allowed more waking time without additional stress