



Conference Abstract

Comparative Analysis of Effort Tolerance between National Level and Professional Road Cyclists: A Psychological Approach

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Abstract: Cycling, as a sport, demands not only physical prowess but also a profound understanding of the psychological factors that influence performance (Ouvrard et al., 2019). Among these factors, effort tolerance and pain management stand out as a crucial determinant of success in competitive cycling. The aim of the present study seeks to elucidate the disparities in effort tolerance between national level and professional road cyclists. By examining various psychological variables such as perceived exertion, pain perception, pleasure, motivational factors, and electroencephalography responses, we aim to uncover the nuanced differences that underpin the performance disparities observed in these two cohorts. Eleven amateur and 11 professional cyclists participated in a maximal graded test until exhaustion and a 'Finish Race Test'. This test was designed to simulate the final portion of a cycling race, aiming to evaluate both psychological and physiological responses to high-intensity effort. The ANOVA test revealed a significance group effect for relative MAP but not for maximal oxygen uptake. During the test, the relative body mass PO (W.kg-1) was significantly higher for the PRO nevertheless the relative effort (%MAP) was not different between the both groups. PRO revealed a higher mean RPE in comparison to AM group but also for the quads pain and the pleasure was significantly lower for the PRO than AM. Higher neural efficiency was found for the PRO compared to AM. Compared to amateurs, pros tolerate higher levels of effort and pain with a lower neural efficiency.

Keywords: Perceived Exertion, Electroencephalography, Motivation, Exercise

1. Introduction

Cycling, as a sport, demands not only physical prowess but also a profound understanding of the psychological factors that influence performance (Ouvrard et al., 2019). Among these factors, effort tolerance and pain management stand out as a crucial determinant of success in competitive cycling. Effort tolerance encompasses the

ability to endure physical discomfort, regulate perceptions of exertion, manage pain (Spindler et al., 2018), and sustain motivation during intense exercise bouts (Ekkekakis et al., 2005).

In the realm of competitive cycling, a distinction exists between national level (AM) and professional (PRO) cyclists, characterized by differences in training regimens, competitive experiences, and



performance outcomes (Joyner et al., 2008). It's plausible to speculate that these differences may contribute to superior effort tolerance compared to their national level counterparts.

The aim of the present study seeks to elucidate the disparities in effort tolerance between national level and professional road cyclists. By examining various psychological variables such as perceived exertion, pain perception, pleasure, motivational factors, and electroencephalography responses, we aim to uncover the nuanced differences that performance underpin the disparities observed in these two cohorts. hypothesize that the elevated training loads and competitive pressures encountered by cyclists professional facilitate development of enhanced effort tolerance, particularly in the context of intense exercise scenarios.

2. Materials and Methods

Eleven amateur and 11 professional cyclists participated in two laboratory visits. During the first visit, they underwent on a cyclo-ergometer a maximal graded test until exhaustion to determine their Maximal Aerobic Power (MAP) and maximal oxygen uptake (VO₂max).

The second visit involved a standardized 15-minutes warm-up, then, the participants engaged with their own bicycle on a treadmill in a 'Finish Race Test' lasting 44 minutes. During this exercise, participants self-selected their treadmill speed to achieve the best average power output during each step. The test was designed to simulate the final portion of a cycling race, aiming to evaluate both psychological and physiological responses to high-intensity efforts (see Figure 1).

Throughout the test, mechanical power (PO) was measured using Shimano R9000 cranksets, along with cadence, heart rate, and respiratory frequency (Carré Technologies Canada). Que., Additionally, participants were prompted at specific intervals to rate their perceived exertion and quad pain using the CR10 scale (Borg, 1998), as well as their pleasure levels (Baron et al., 2011) but also their neural efficiency (α/β ratio) in the cortical regions (Mentalab US LLC, San Diego, CA). Prior the test, participants' motivation levels were assessed using the Multidimensional Motivation Scale during Effort (Baron et al., 2022).

3. Results

The T-test revelated a significance group effect (p = 0.02; Cohen's d = -1.244) for relative MAP (AM = 5.9 ± 0.6 W/kg; PRO = 6.4 ± 0.5 W/kg) but not for maximal oxygen uptake (p = 0.738; Cohen's d = 0.104).

During the test, the relative body mass PO (W.kg⁻¹) was significantly higher for the PRO (p = 0.018; η^2 = 0.027) (AM = 4.8 ± 1.63; PRO = 5.3 ± 1.92 W/kg) nevertheless the relative effort (%MAP) was not different between the both groups.

PRO revealed a higher mean RPE in comparison to AM group (p = 0.023; η^2 = 0.035) (AM = 5.1 ± 2.3; PRO = 6.0 ± 2.7 a.u) but no for the quads pain and the pleasure. Moreover, the affective load was significantly higher for the PRO than AM (p = 0.047; η^2 = 0.092) (AM = 0.6 ± 3.7; PRO = 2.8 ± 4.3 a.u).

No significant difference was found for the neural efficiency for the PRO compared to AM for the prefrontal, motor and parietal cortex (AM = 1.49 ± 1.11 ; PRO = 1.20 ± 0.67 a.u).

No significant difference of motivation was observed between both groups.

Table 1. Mean values (Mean) and standard deviation (SD) of different variables. Intensity Zone (IZ) was calculated from of the rate of subjective exercise intensity (RSEI) scale (Grappe, 2018). *p<0.05 compared to IZ2.

					nte	Intensity Zo	Zones (IZ)	(Z								ANOVA				sut
		I Z2	۵.	EZI				, IZ5		9ZI	' 0		ZI			Groups		_	ZxLevel	
		mean	ps	mean	ps	mean	ps	mean	ps	mean	ps	F	р	η²	Ь	р	η²	Ь	р	η²
Absolute Dower (M/)	РΑ	215	23	×69Z	22	331*	37	383*	44	532*	9/	501.00	7000	2000	151	66.0	9000	20.0	200 0	2000
Absolute rower (w)	PRO	219	28	291*	34	340*	29	383*	39	288 _*		67.129	00.0	0.900	- - - -	0.43	0.000	7.7	0.000	
Belative Bower (M/kg)	Α	က	0.3	3.7*	0.4	4.5*	0.5	5.3*	0.5	7.3*	1.1	77 7 7 7 7 4	200	000	70	9	7000	300	5	
netative rower (wing)	PRO	3.2	0.4	4.3*	0.5	5*	0.4	5.6*	9.0	*9.8	8.0	5/4./	00.0	0.882	6.04	0.0	0.02/	3.63	- 0:0	-
Ochtivo Downer (07 MAD)	ΑΜ	51	2	*49	9	*6/	œ	*26	6	127*	16	0	700		0	6	0	6	7	
netative rower (2017AF)	PRO	20	9	*99	4	78*	2	*28	7	134*	10	227.83	0.00	0.938	0.03	0.877	0,00	80.1	0.1/4	600.0
Cadoboo (ram)	Α	98	7	98	œ	06	4	88	4	83	4	ç	0		Ç	2	6	c c	0	
cadelice (ipili)	PRO	85	9	88	7	92	4	87	7	89	6	2.49	0.039	0.039	0.00	0.012	0.00	0.20	0.092	10.0
Hoart rate (hom)	ΑМ	157	11	158	10	172*	6	182*	6	178*	10	00 101	7000	7030		0.000		70	0 505	
riearciate (ppini)	PRO	157	1	158	11	173*	6	180*	7	180*	10	56.101	00:0	0.007	0,00	706.0	0,00	0.0	0.323	500.0
Fractional rate (myt/min)	Α	43.5	7.1	39.2	7.9	49.2	8.6	27*	10.4	£6.6*	11.7	00 01	500	000	77	0770	000	90	6990	2
	PRO	46.9	6.9	42.3	6.4	51.5	7	57.4*	7.9	61*	10.6	10.00	.00.0	0.00	10	0.413	0.021	0.0	0.002	
Perceyeld exertion (a. 11)	ΑМ	2.9	8.0	2.9	9.0	4.8*	1.1	7.5*	1.1	7.5*	1.2	157.04	70007	0.917	7 94	0.00	0.025	1 7.1	0.167	2000
י כוככייכות כאכותים (מ.מ)	PRO	3.2	1.6	3.6	7:	6.3*	2.1	*	1.5	8.7*	1.1	10.70	00.07	20.0	17:/	0.020	20.0	-	5.	
Derceyeld pain (a)	ΑM	5.9	_	2.5	8.0	4.8 _*	1.2	7.3*	1.7	¥9.′L	1.6	116.45	,	632.0	77.	0.057	0000	5	0.413	4p
reiceveld paiii (a.u)	PRO	3.2	1.6	3.7	1.4	*9	2.2	7.8*	2.1	8.7*	1.8	10.43	00.0	0.762	6/.4	0.034	0.032	5	0.412	
Measured pleasure (a. i.)	ΑΜ	5.3	1.9	5.5	1.8	4.6	1.9	3.1	1.7	4	2.2	ν α	7000	0.106	98 6	0 100	ر 1	1.63	185	2 200
icasaica picasaic (a.a)	PRO	3.5	5.6	3.6	2.3	3.3	2.2	3.2	3.1	7	2.5	t o	00.07	5	7.00	0.122	2	3	5	
Affective load (a. ii)	РΜ	-2.4	2	-2.6	2	0.1*	2.2	4.3*	2.2	3.6*	2.9	77 01	,	0 522	л	2700	000	70	0 100	2).
אווכנוועכ וטממ (מ.מ)	PRO	-0.3	3.9	0	2.8	2.9*	3.9	4.8*	3.7	6.6 *	3	14.01	.00.0	0.00	00	0.047	0.032	+6.1	0.123	
a/8 central ratio	РΑ	4.6	1.1	4.2	0.7	4.6	1.1	4.8	6.0	4.9	9.0	1 16	0.050	2000	600	220 0	0.001	07.0	0.754	70.
wp cellifatiatio	PRO	4	1.2	4.2	8.0	4.6	0.7	4.6	1.4	4.7	-	2	0.552	0.000	50.0	0.000	0.00	0.40	0.73	
a/8 frontal ratio	ΑΜ	3.7	[3.9	7:	3.7	1.4	3.7	-	4.3	_	62.0	0 200	0.00	7	777 0	3000	99 0	7630	20
Z	PRO	3.7	1:1	4.4	1:1	4.2	0.7	4.5	1.6	4.3	0.7	7/10	999	2000	-	ì.		9	0.027	
a/B pariotal ratio	РΜ	3.9	1.2	4.3	1.2	4.1	_	4.2	1.3	4.5	1.4	,	0 175	000	ć	C C		00	907	2
wp palletatlatio	PRO	3.9	1.3	3.9	1	4.1	6.0	3.7	1.3	4.5	1.2	1./.1	0.173	0.000	0.32	0.39	0.01	0.00	0.400	

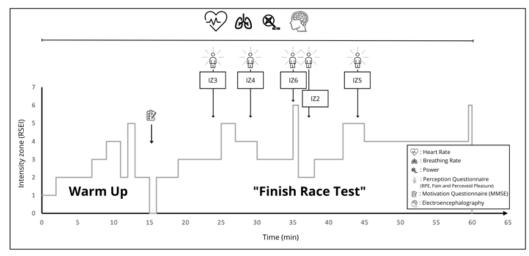


Figure 1. Design of the study.

4. Discussion

The professional cyclist shows a better capacity to develop higher power (W.kg), associated with a higher perceived exertion and affective load, whereas their VO2max was not significantly different of amateurs. It seems that this difference is not caused by the motivation level or neural efficiency. While it has been shown that there are differences in brain function between athletes and nonathletes (Del Percio et al., 2009). It has also been suggested that this neurological signal could be linked to perceptual measures, notably RPE and pain. Moreover, higher affective load encountered by PRO suggest they are less sensible to pleasure than AM to realize a performance.

5. Practical Applications.

These results highlight the benefit of training specific to pain and high effort intensities to better support amateurs during their transition to professional cycling.

6. Conclusions

Compared to amateurs, pros tolerate higher levels of effort and pain without a lower neural efficiency.

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