A single field test evaluation for the assessment of the Record Power Profile in cycling

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Background: Power output represents a pertinent metric to assess the performance level in cyclists. In this context, the Record Power Profile (RPP) reflects the best power output spectrum of an athlete recorded during training and competitions (Pinot & Grappe, 2011). To date, several laboratory or field tests separately allow to determine the successive points necessary to build a cyclists RPP. To the best of our knowledge, the overall validity of a single field test evaluation to produce a RPP has not been investigated thoroughly in comparison with a more robust RPP obtained during a whole cycling season.

Purpose: This study was conducted with 8 elite cyclists and proposes a single field test evaluation (Peak Power Profile test (PPP)) to establish a preliminary RPP and to compare the latter with a RPP calculated over the time course of an entire cycling season. We first investigated if RPP values were obtained mostly during training sessions or during competitions. We hypothesized that cyclists would reach the highest power outputs during the more specific training sessions rather than during racing. Second, cyclists had to perform a PPP including successive bouts of all-out efforts of several duration (from 5 s to 20 min) with self-paced warm-up and individual recovery phases to allow to reach peak power outputs for each duration on an adequate terrain. We hypothesized that the values obtained from a single PPP would match closely the values obtained during the season to define a RPP.

Methods: For the purpose of the study, we recruited eight male elite cyclists (23.8±4 y, 66.6±5.8 kg, maximal aerobic power 6.8±0.4 W/kg) competing at an international level (UCI Elite International license) in track cycling, mountain-bike and road cycling. Their power output was recorded during 12 months from October to September to determine their RPP. The cyclists completed a single PPP during the competitive season (between June and August) following the protocol illustrated in Table 1. Briefly, subjects performed all-out efforts of 5 s, 12 s, and 30 s followed by efforts of 5 min and 20 min. The cyclists were required to self-select their itinerary and pace their own warm-up and recovery efforts to allow for their best power output on the most adequate terrain. Power data were recorded at 1 Hz with the cyclists' own power meter (SRM) and HR belt at 1 Hz and computed in a dedicated software (Golden Cheetah) to allow for the quantification of their training load and automated determination of their RPP.

Results: The cyclists covered an average yearly cycling distance of 16021 ± 4575 km during the season. A significant positive correlation was found between the overall peak power outputs obtained during the single PPP-test and i) during training sessions during the season (R^2= 0.97, P= 0.05) (Fig. 1) and ii) competition (R^2= 0.91, P= 0.05) (Fig. 2). However, when analysed individually, peak powers recorded during the PPP-test were higher than in competition for short efforts of 12 s (P= 0.05) and 30 s (P= 0.05) (Table 2). Conversely, the best 20 min power output tended to be higher in competition than during the PPP-test (P= 0.05) (Table 2). The individual distribution of the peak PO in different conditions illustrated that specific training sessions represented the most common situation to achieve a record PO (55% of the cases) followed by the PPP-test (27.5%) (Fig. 3). The pattern of intensity and duration during the warm-up and recovery phases was similar in all cyclists without any precise external recommendations (Table 3).

Discussion: This study reports the interest for a cyclist to perform a single PPP to establish a RPP that would closely match potential values obtained during the rest of the season during training (for shorter efforts) or competition (for longer efforts). However, short all-out efforts may alter the power output of a subsequent 20 min maximal effort. The similar warm-up and recovery patterns illustrate a good reliability of the test when utilized to compare the objective level of cyclists at a given time point.

Conclusions: Our study highlight the utility of a single field test to establish a valid Record Power Profile in elite cyclists. The very high-power outputs obtained during the single Peak Power Profile test make it a reliable tool for cyclists and trainers to define training regimens and target power zones. The underpinning strong motivation needed to reach ones peak power output over successive durations during the test may limit its validity over longer duration. It may be recommended to extrapolate peak power for longer efforts or use competition data to be included in a profile.

Reference:

Pinot, J., & Grappe, F. (2011). The record power profile to assess performance in elite cyclists. *International Journal of Sports Medicine, 32*(11), 839-844. doi:10.1055/s-0031-1279773

Phase	Time / Effort	Description
Warm-Up	Self-management of duration and intensity	Select your own terrain according to your cyclist characteristics.
Main set	**5 seconds**	**Free start velocity - All-out effort**
	Recovery	Self-management
	15 seconds	**Free start velocity - All-out effort**
	Recovery	Self-management
	30 seconds	**Free start velocity-Go as hard as you can**
	Recovery	Self-management
	5 minutes	**Free start velocity - Maximal capacity**
	Recovery	Self-management
	20 minutes	**Free start velocity - Maximal capacity**
Cool-down	Free	Easy Ride

Table 1: Peak Power Profile test protocol

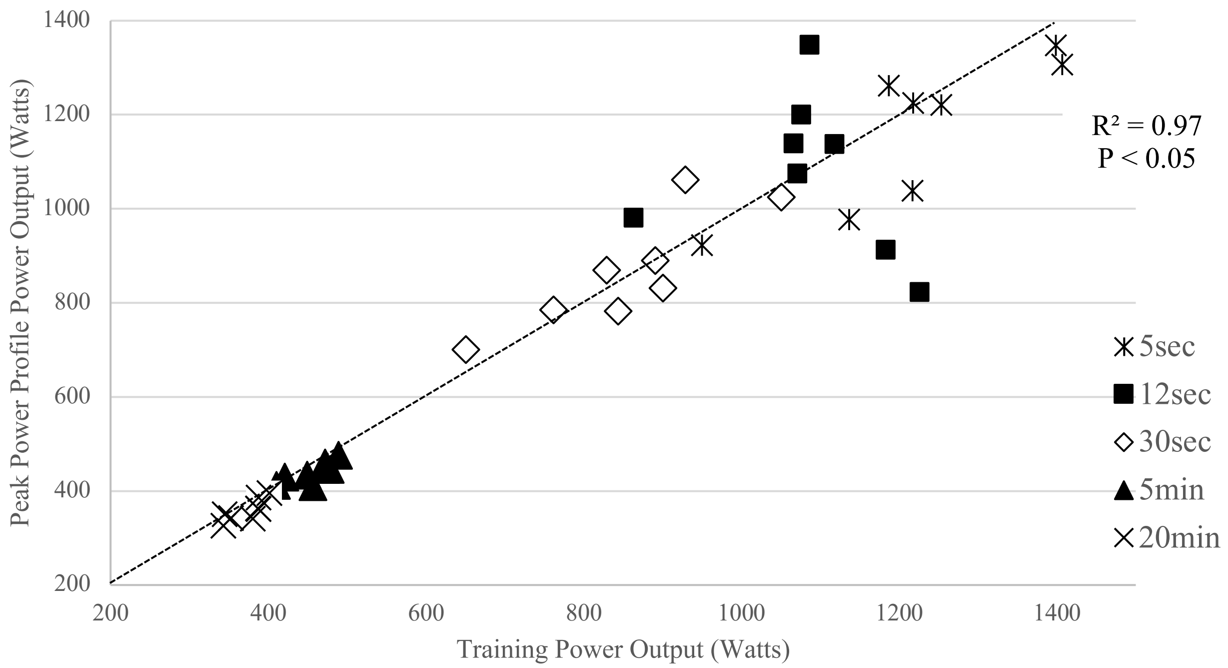

Figure 1: Correlation between the power output during the Peak Power Profile-test and Training sessions

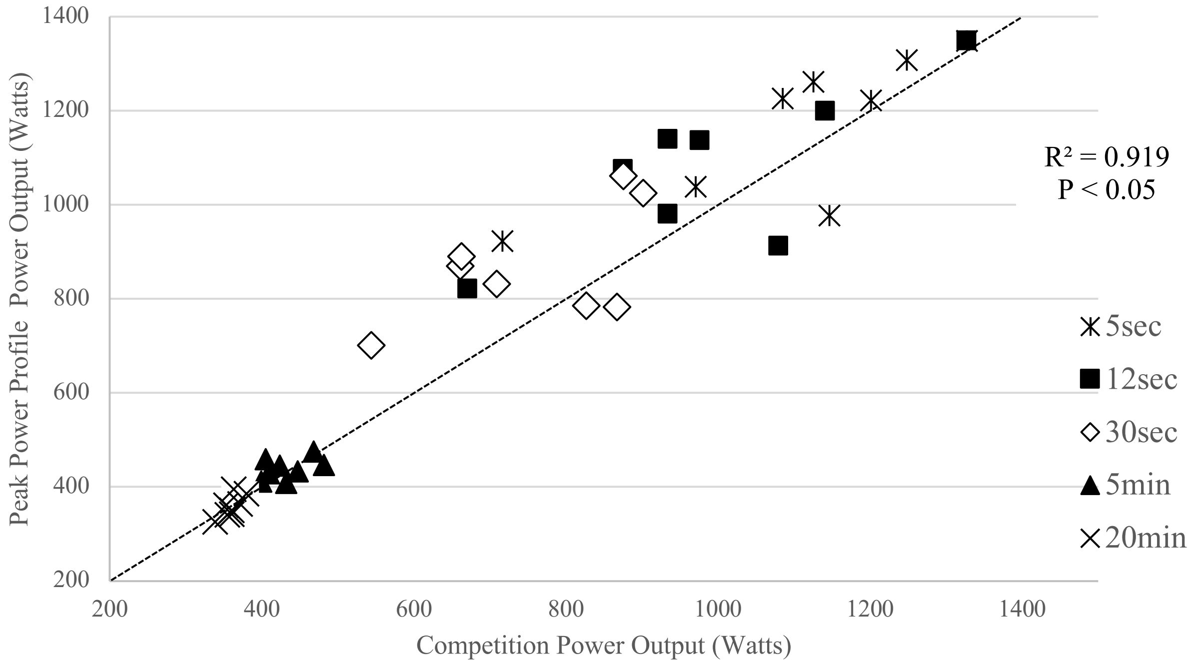

Figure 2: Correlation between the power during the Peak Power Profile-test and Competitions

Absolute (W)and Relative (W·kg^{-1}) Power Output (W)	Efforts	Test	Training	Competition	Test vs. Training	Test vs. Competition	Training vs. Competition
N=8	5 s	1163±159 17.5±2	1221±147 18.3±1.5	1102±189 16.5±2	0.09	0.16	0.007
	12 s	1065±147 16±2	1087±107 16.3±0.9	955±14 14.3±1	0.46	0.04	0.008
	30 s	869±123 13±1	857±119 12.8±1	756±13 11.3±1	0.63	0.02	0.02
	5 min	439±2 6.6±0.4	457±28 6.8±0.4	433±30 6.5±0.3	0.03	0.54	0.03
	20 min	359±2 5.4±0.4	373±23 5.6±0.4	360±12 5.4±0.3	0.02	0.88	0.08

Table 2: Maximal Power Output measured during the Peak Power Profile-test, training sessions and competitions. Values expressed as means ± SD

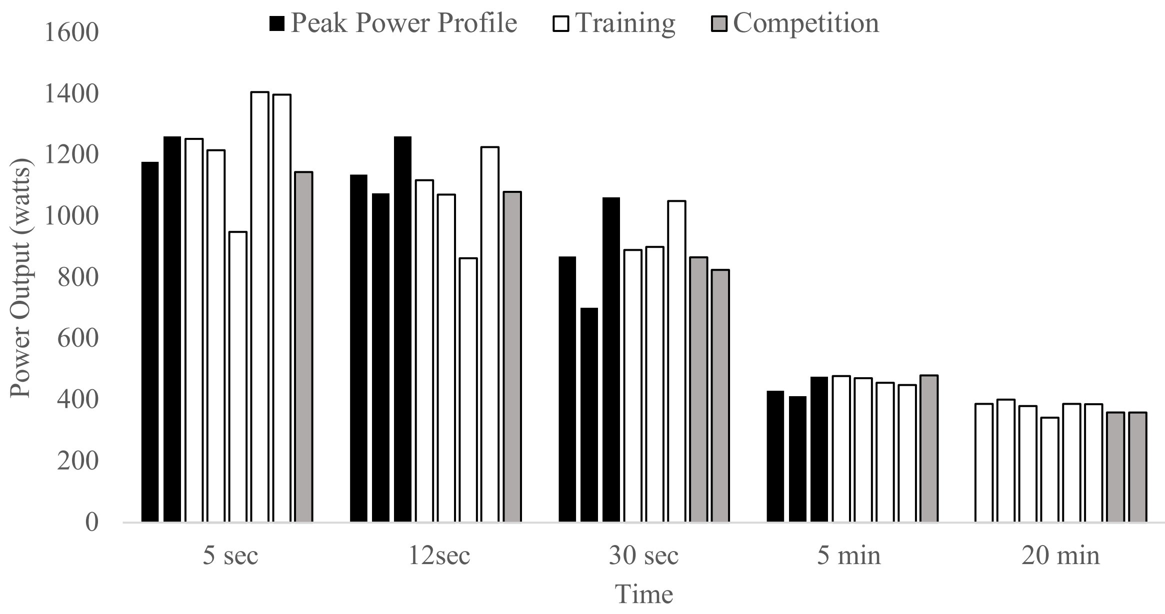

Figure 3: Peak Power output (W) and distribution of the conditions in which it was reached in the eight subjects

Efforts	% Road gradient	Recovery time (sec) after efforts	Power on recovery effort times (Watts)
5 s	1.2±1.7	363±82	186±32
12 s	1.0±0.8	470±81	190±45
30 s	2.7±0.9	872±101	156±36
5 min	7.5±0.6	1464±217	160±49
20 min	6.6±1.7	-	-

Table 3: Effort regulation during the Peak Power Profile-test. Values expressed as means ± SD