Maximal aerobic power-cadence relationship estimation on national level u19 cyclists from *in-situ* data

Laboratoire Interuniversitaire de Biologie de la Motricité

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UNIVERSITÉ SAVOIE MONT BLANC

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Background

- Power profiling has been well studied during the last decade (Allen and Coggan, 2010, Quod *et al*., 2010,Pinot and Grappe, 2011, Leo, Spragg *et al*., 2020, Sanders and Van Erp, 2020, Leo *et al*., 2020,2022, Muriel et al ., 2021, Van Erp e*t al*., 2022, Gallo *et al*.,2022).

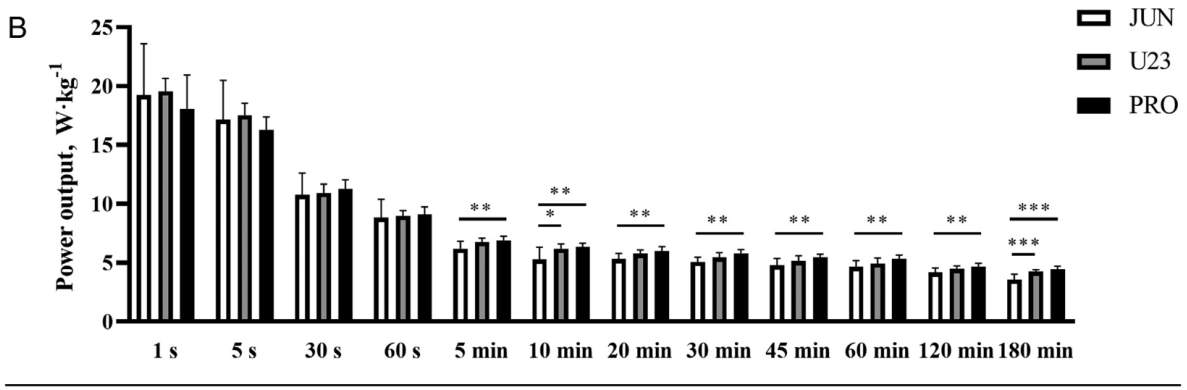


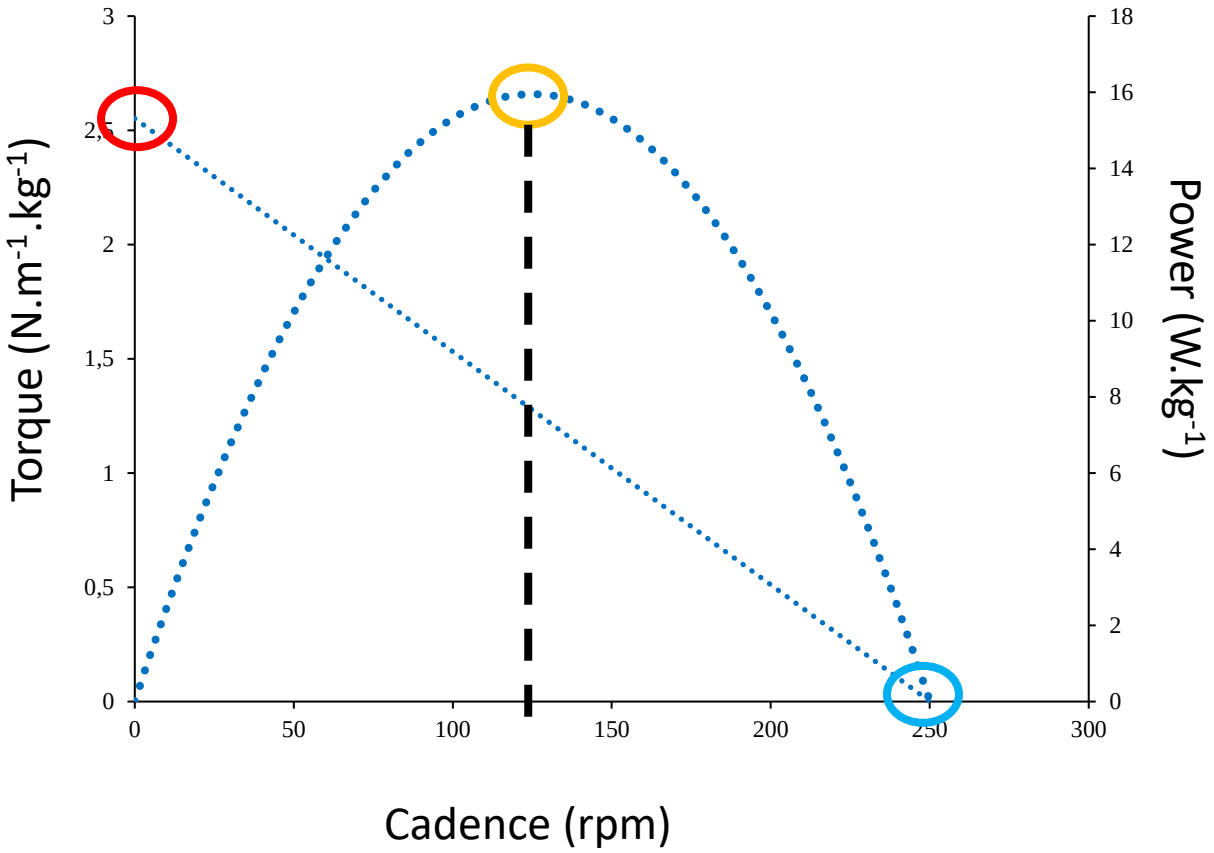
Figure 2 — Absolute (A) and relative (B) mean recorded power outputs over the corresponding time durations considering 13 time frames (1, 5, 30, 60 s and 5, 10, 20, 30, 45, 60, 120, 180, 240 min). JUN indicates junior; PRO, professional; U23, under 23. Significant difference between the groups (*$P < .05$, **$P < .01$, and ***$P < .001$).

- Performance analysis
- Training zones
- Differentiate populations
- Training prescriptions
- Assess performance capacities

Gallo *et al.* (2022)

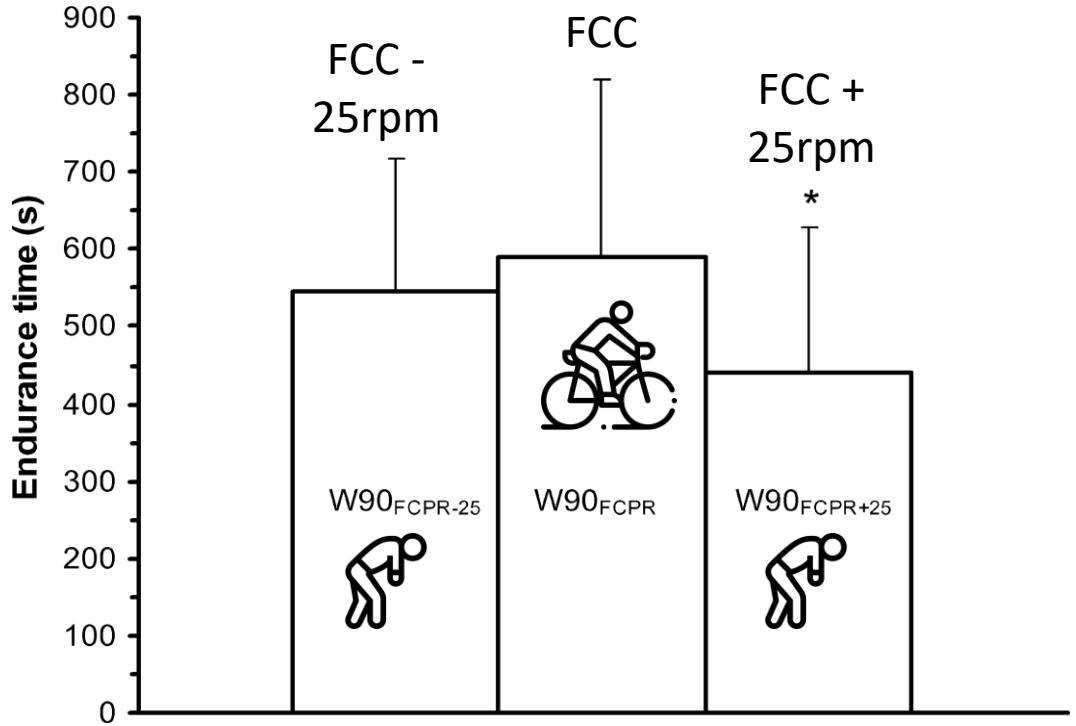
Background

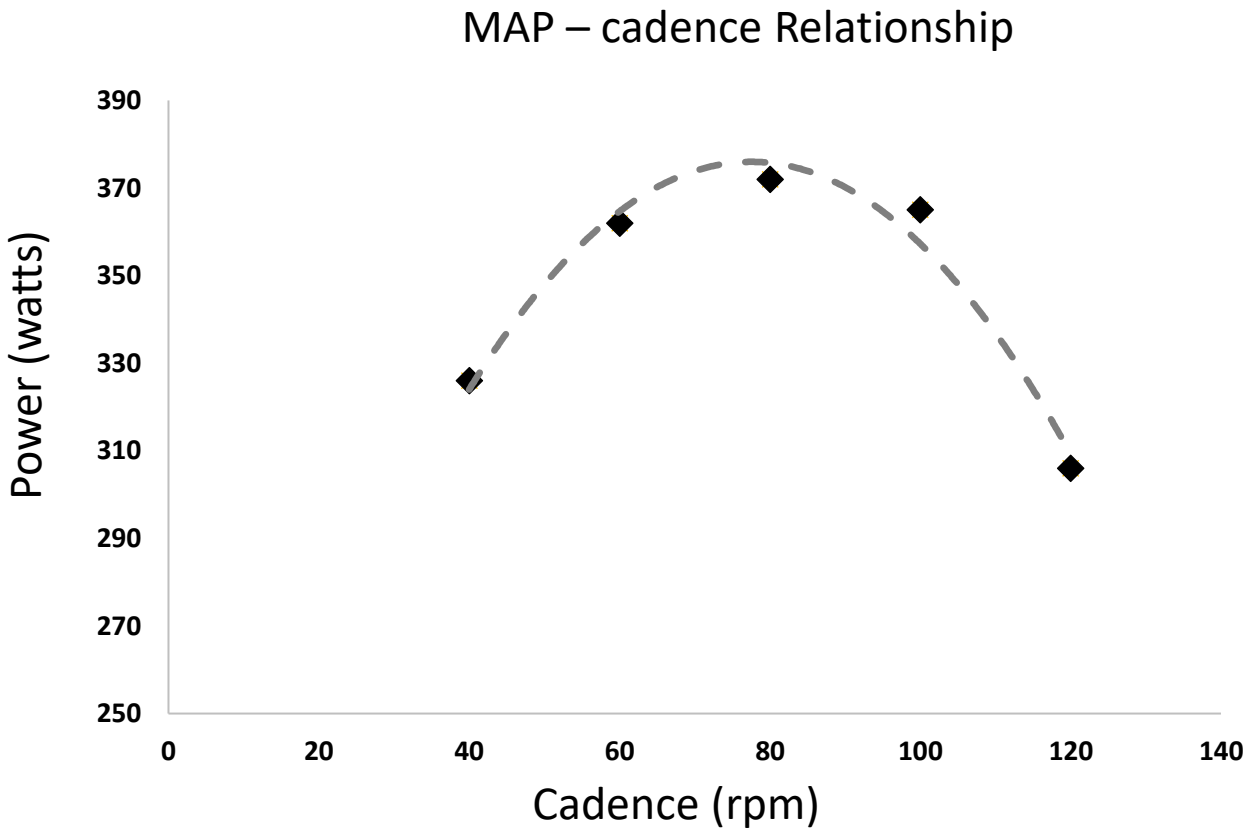
$$Power = Torque \cdot Cadence$$



- Power – Torque – Cadence relationship (Vandewalle *et al.*, 1987, Hintzy *et al.*, 1999, Driss and Vandewalle, 2013, Dorel *et al.*, 2015 ; Bobbert *et al.*, 2016, Robin *et al.*, 2022).
  - Linear relationship between torque (T_0) and cadence (C_0).
  - Polynomial relationship between power and cadence.
  - **Maximal power (P_{max})** attained at optimal cadence.
  - Useful to characterize cyclists on T_0, C_0 and P_{max}.

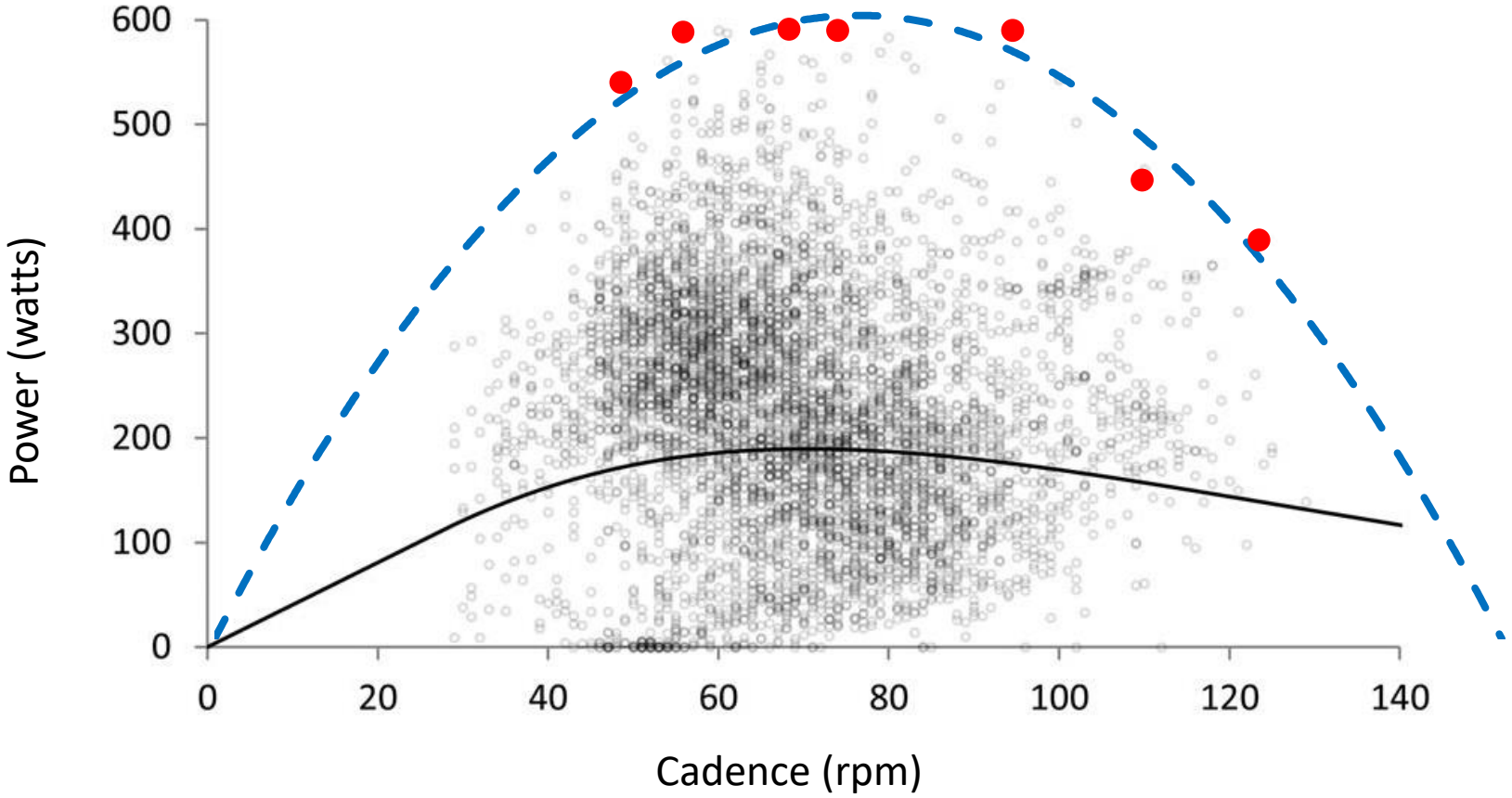
Background





- Time to exhaustion may be reduced if the cadence adopted is not the optimal one (Nielsen *et al.*, 2004).
- MAP can be reduced if the cadence is not the optimal one (adapted from Zoladz *et al*., 2000).

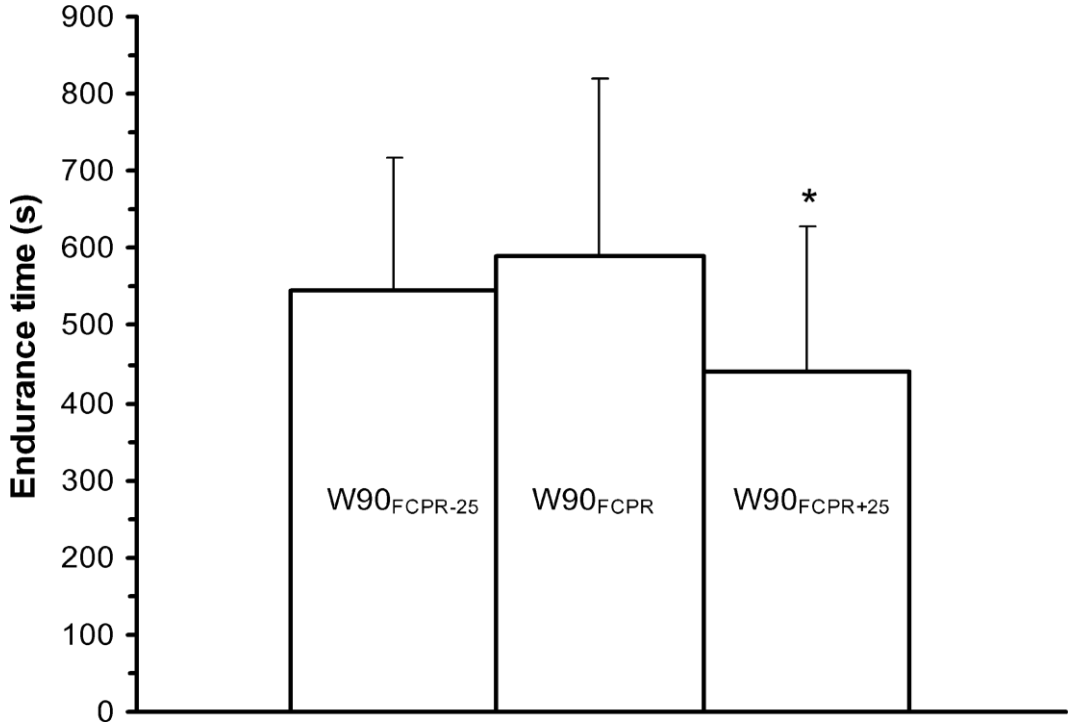
Background



Reed *et al* ., (2007), attempt to modelized power – cadence relationship with field data.

Background

- The compromise between torque and cadence will impact the ability to produce the maximal power for a given duration.



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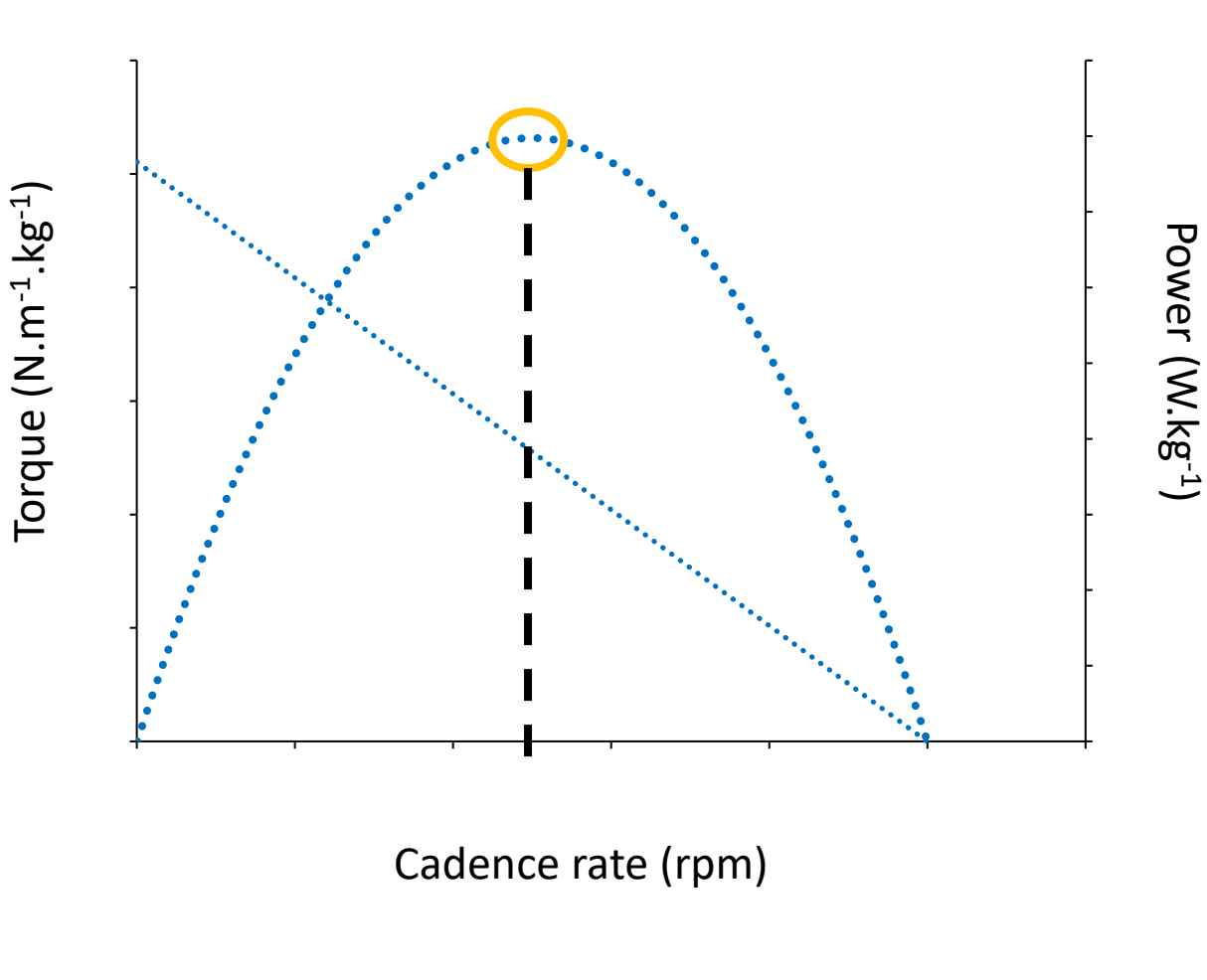
- Is it possible to modelized an optimal cadence that permits to reach the maximal power produce for longer given duration than explosive efforts ?



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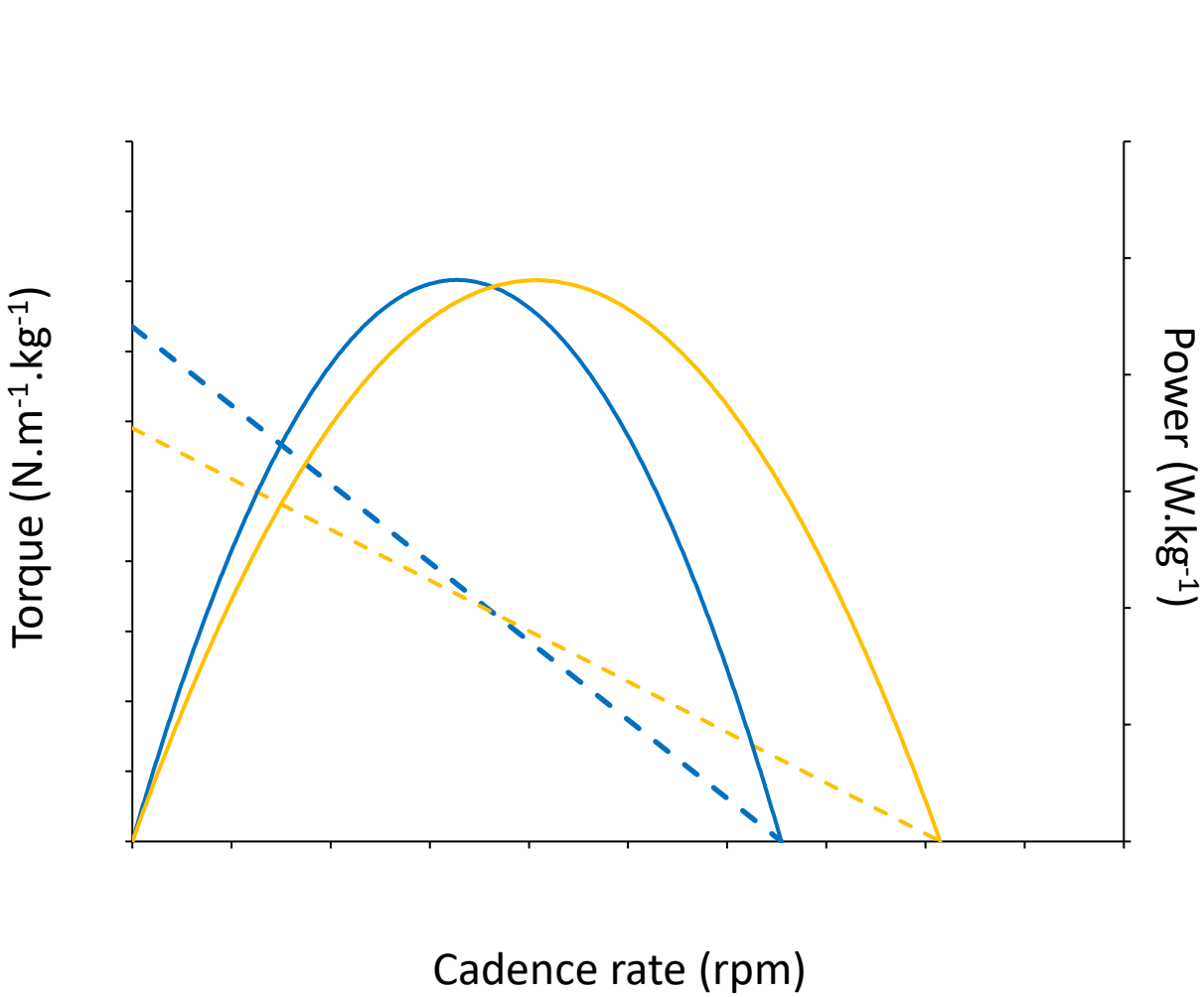

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✓i) Test the fitting and reliability of $power_{record}$ – cadence for a 5-minutes duration.

✓ii) Demonstrate that the $power_{record}$ – cadence relationship for a 5- minutes duration is polynomial.

Materials and Methods

- 14 subjects (17 ± 1 years, 66.9 ± 4.4 kg, 11 ± 1.5h of training/week).
- One complete season of training and racing database, with retrospective analysis.
- Power, cadence and time were recordered with a cycling computer (*Wahoo, ROAM, West Wieuca Rd NE, Atlanta, USA*), and torque values were calculated with power and cadence data.

Materials and Methods

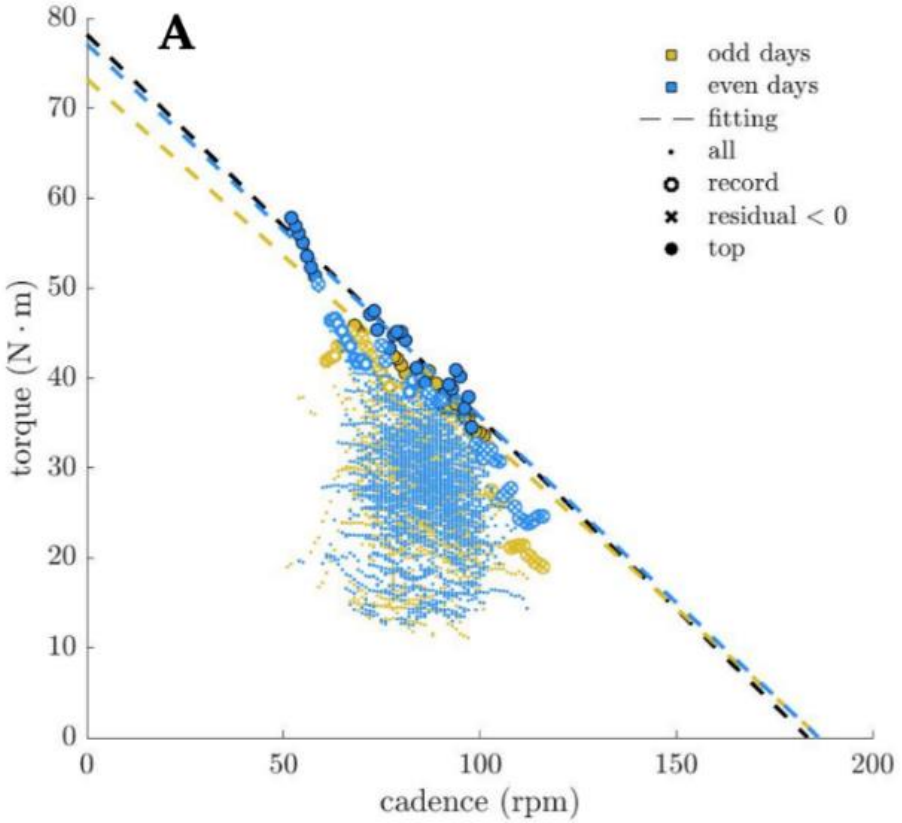
- $Power_{record}$ for a 5- minutes duration for each mean cadence from 50 to 120rpm.

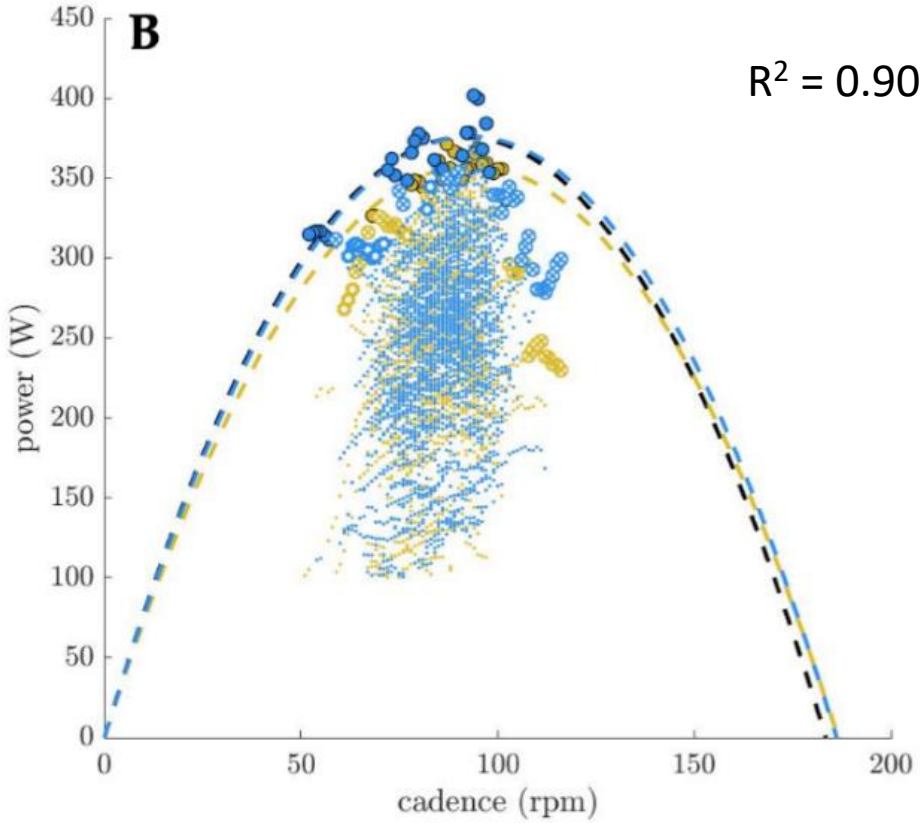
- The reliability was tested with odd and even days data separated.

- ICC and SEM analysis were used to test the reliability of $power_{record}$ – cadence relationship, for C_{opt}, T_{opt} and P_{max} *(i,e, optimal cadence, optimal torque and maximal power).*

Results & Discussion

	Copt	Topt	Pmax
ICC	0.76	0.90	0.94
SEM	4.3 rpm	2.2 $N.m^{-1}$	10.8 watts





R^2 = 0.90 [0.82 – 0.94]

Figure 1. Torque – Cadence relationship (A) obtain from training and racing data for odd days (yellow circles) and even days (blue circles), with bold circle represent the torque – cadence record points. Power – Cadence relationship (B) modeled from the Torque – Cadence relationship, expressed in power.

Results & Discussion

Indicators	Mean	SD
P_{max} (watts)	401	39
C_{opt} (rpm)	91	8
T_{opt} ($N.m^{-1}$)	42.6	7.0

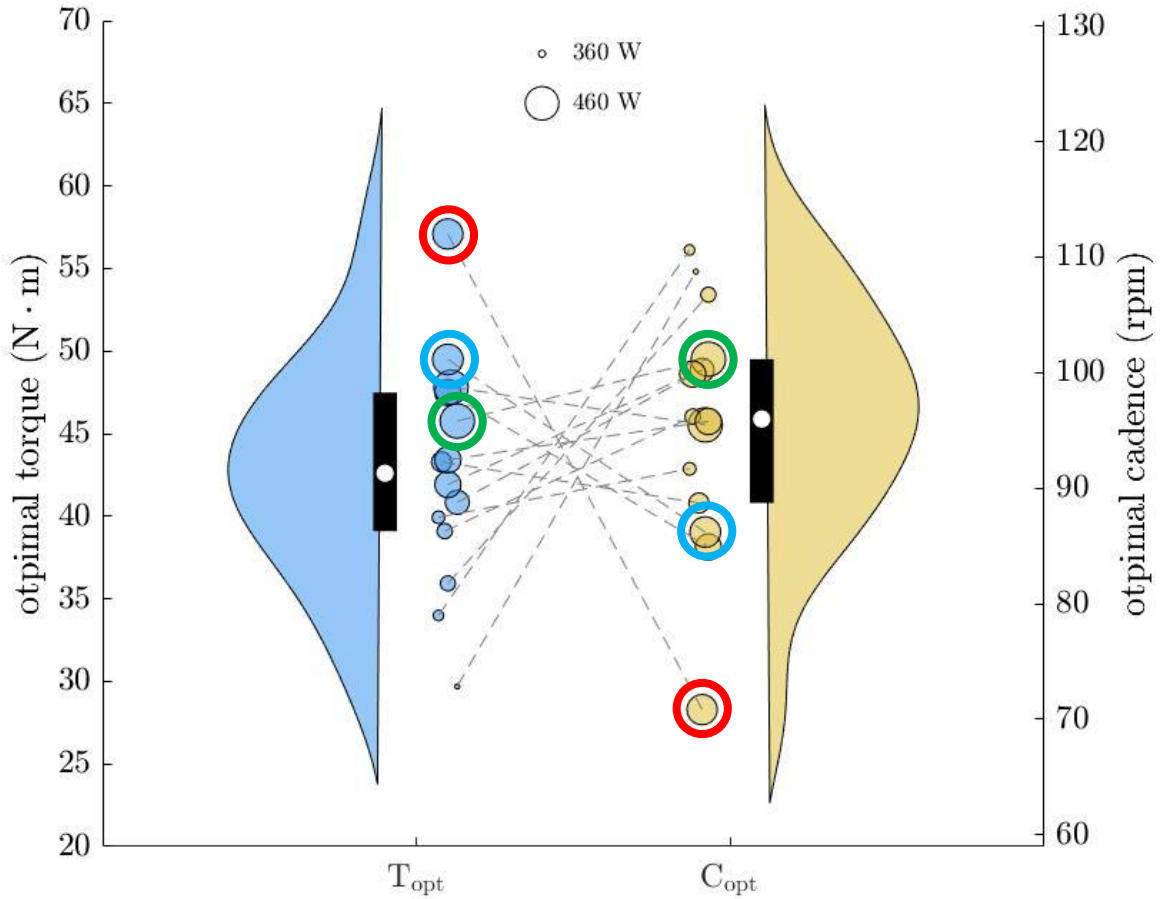


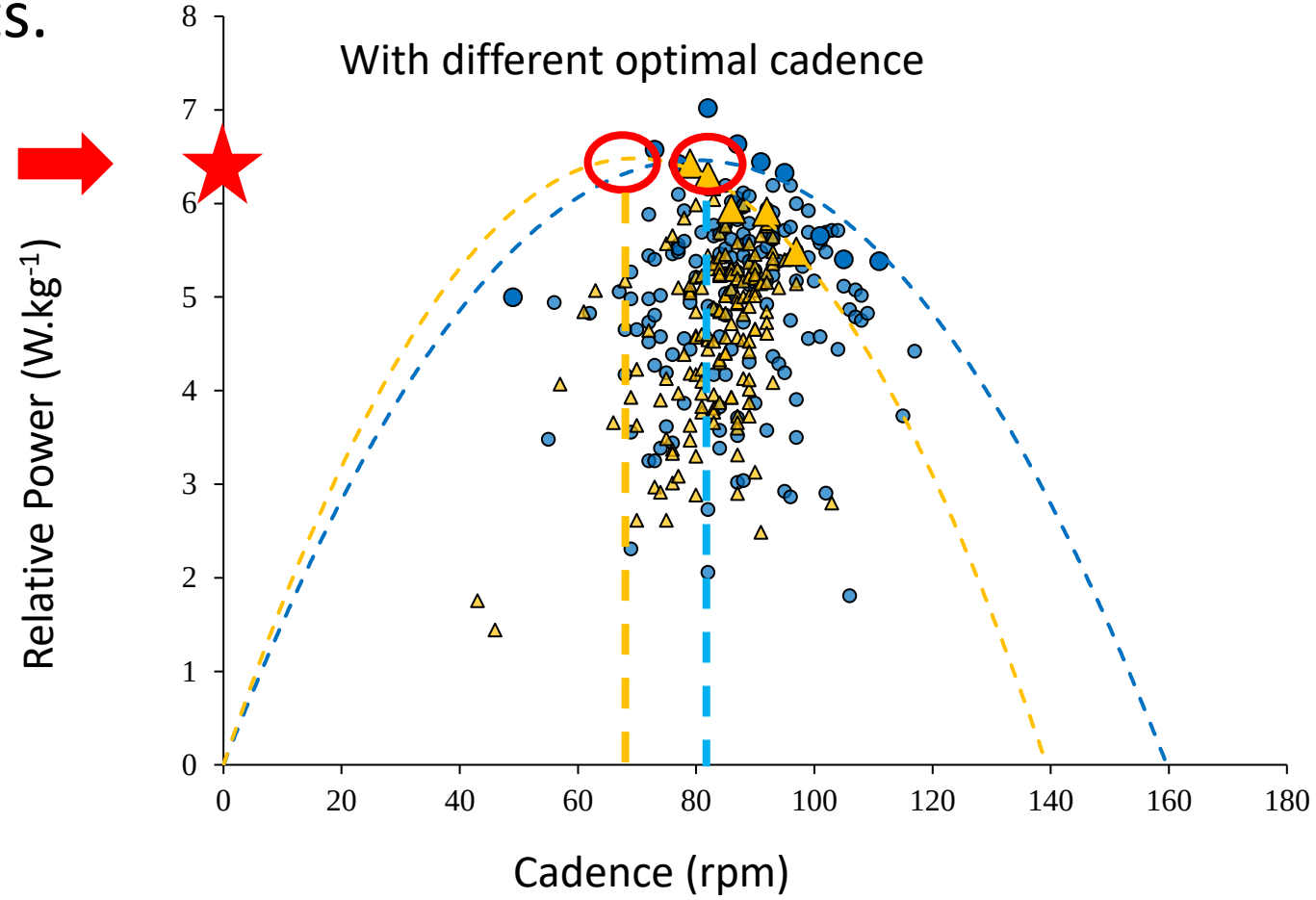
Figure 2. Optimal torque and cadence Violin plot for 5-min MMP. Dashed lines link each individual. P_{max} is represented by means of dot radius.

Power production capacities are not always torque or cadence oriented, it depends on the **cyclist characteristics**.

Conclusion and practical applications

- Example with data from field (racing or training) with national level u19 cyclists.

Similar relative PO



Conclusion & Practical applications

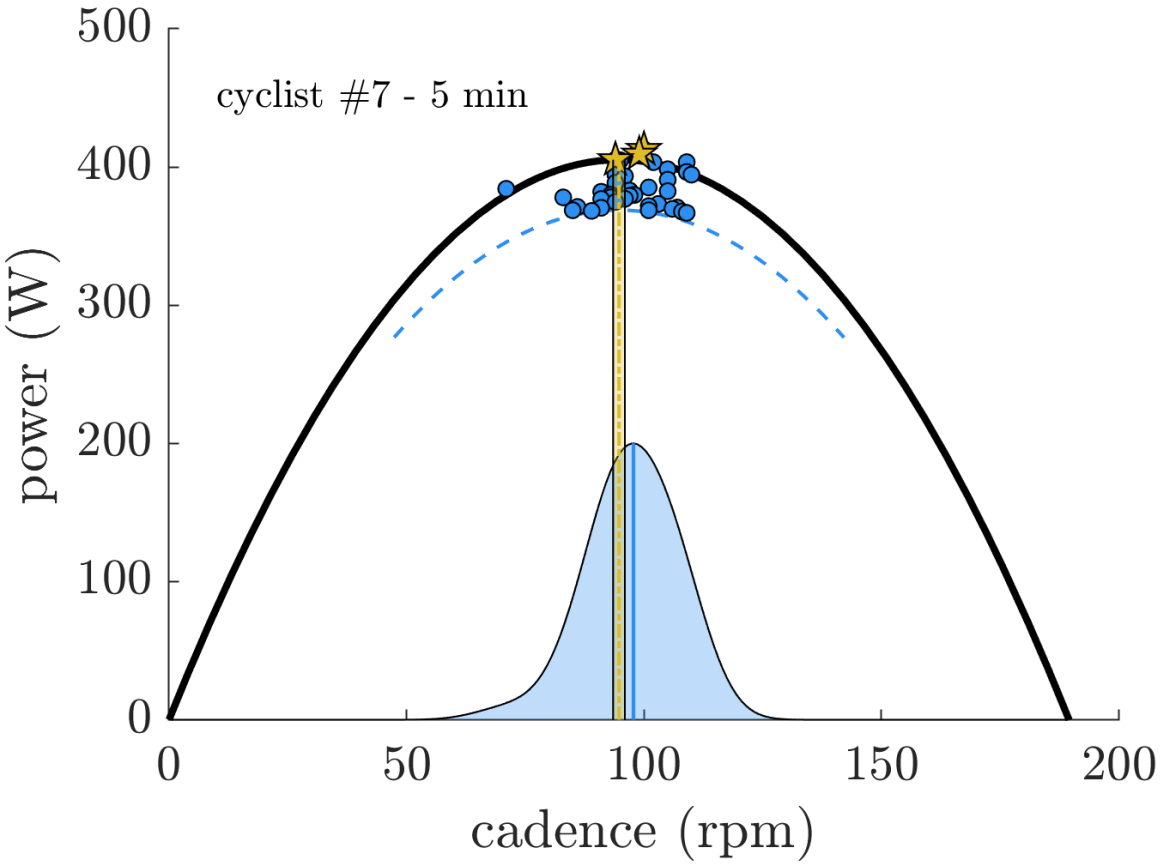
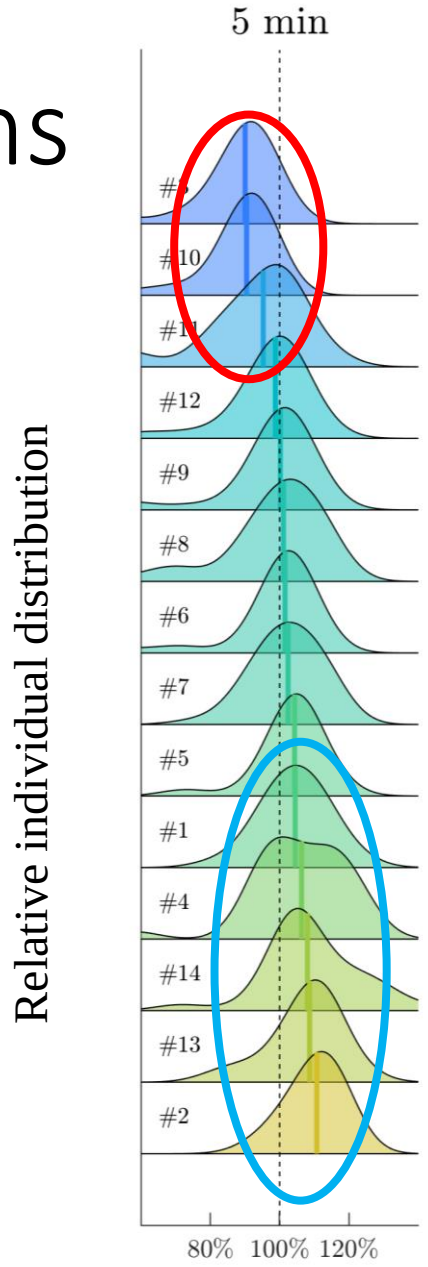


Figure 3. Typical cases of $power_{record}$ – cadence and cadence distribution for effort at least at 90% $power_{record}$ – cadence or at $power_{record}$ – cadence.

Conclusion & Practical applications

- Various torque – cadence profiles can produce a same power$_{record}$.
- Assist the gear selection.
- Test the ability for a cyclist to select the optimal cadence.
- Prioritize torque or cadence training based on the individual torque – cadence profile.



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