



# Science & Cycling

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## Individualising training intensity to reduce inter-individual variability in training response in trained cyclists.

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**Keywords:** training, individualisation, high-intensity, cycling, individual variability.

**Background:** Training to improve endurance performance commonly results in large inter-individual variability (IIV) in response (Bouchard *et al.* [1998]. *Medicine and Science in Sports and Exercise*, 30(2), 252–258; Mann *et al.* [2014]. *Sports Medicine*, 44, 1113–1124). A novel perspective to this issue centers on the differences in physiological response at set percentages of maximal performances; commonly used to prescribe training (Coyle *et al.* [1988]. *Journal of Applied Physiology*, 64(6), 2622–2630). By establishing individual profiles of performance using a Power Law (PL), training intensity could be prescribed on an individualised basis (García-Manso *et al.* [2012]. *Journal of Theoretical Biology*, 300, 324–329).

**Purpose:** This investigation sought to determine whether using a PL could reduce IIV in  $\dot{V}O_{2\max}$  response to training compared to using a standardised method.

**Methods:** Two groups of male cyclists completed 12 high intensity training (HIIT) sessions over 4 weeks. Training intensity was prescribed using PL models in the individualised group (IG; n=5,  $\dot{V}O_{2max} = 57.50 \pm 9.02$  mL.kg.min<sup>-1</sup>) and set percentages of  $\dot{V}O_{2max}$  in the standardized group (SG; n=5,  $\dot{V}O_{2max} = 62.17 \pm 4.45$  mL.kg.min<sup>-1</sup>). A  $\dot{V}O_{2max}$  test and performance time trial were completed pre- and post-training. PL's were established using maximal efforts of 12, 7, and 3 minutes (Galbraith *et al.* [2014]. *Journal of Sports Physiology and Performance*, 9(6), 931–935). Training sessions consisted of 3 sets of 10 repetitions of 30 seconds work and 30 seconds recovery, with 5 minutes active recovery between sets. Statistical analyses were conducted using IBM SPSS Statistics 22, with between- and within-group comparisons completed using independent and paired samples t-tests, respectively. Variability was analysed using log-transformed coefficients of variation and Bland-Altman plots.

**Results:**  $\dot{V}O_{2max}$  was shown to have significantly increased in IG from  $57.50 \pm 9.02$  mL.kg.min<sup>-1</sup> to  $59.36$  mL.kg.min<sup>-1</sup> following 4 weeks of HIIT training prescribed using a PL ( $P < 0.05$ ).  $\dot{V}O_{2max}$  did not significantly improve in SG ( $P > 0.05$ ; *Figure 1*). Intra-class correlation coefficients (ICC) showed that variability in  $\dot{V}O_{2max}$  response in both IG and SG was low, but significantly stronger correlations were observed in IG ( $P < 0.001$ ) than in SG ( $P < 0.05$ ). Individual  $\dot{V}O_{2max}$  response profiles (*Figure 2*) indicate wider variation in response in SG, with two participants showing reduced  $\dot{V}O_{2max}$ , and a more consistent positive response in IG. Bland-Altman plots identify variance in  $\dot{V}O_{2max}$  response of  $+ 4.39$  mL.kg.min<sup>-1</sup> to  $- 0.69$  mL.kg.min<sup>-1</sup> in IG and from  $+ 8.86$  mL.kg.min<sup>-1</sup> to  $- 6.23$  mL.kg.min<sup>-1</sup> in SG (*Figure 3*).

**Conclusion:** The results of this study suggest that individualised HIIT training prescribed using a PL can reduce the IIV in  $\dot{V}O_{2max}$  response to training when compared to a standardised approach. This indicated that prescribing training using a PL model can result in consistent and predictable responses, useful for research, clinical, and applied purposes.

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## Figures

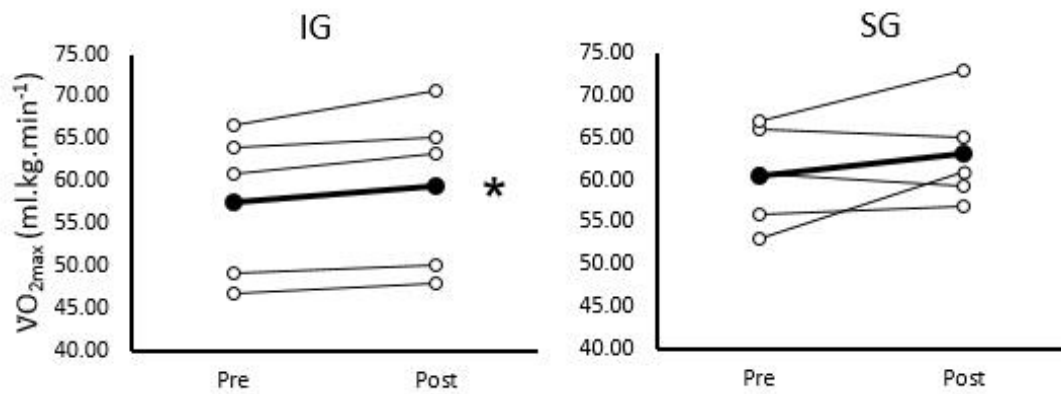


Figure 1 -  $VO_{2max}$  response, identifying both inter-individual variability in response and mean response following 4 weeks of HIIT training. Open circles identify individuals and closed circles identify mean response. \* ICC significance varies between IG and SG ( $P < 0.001$  vs.  $P < 0.05$ , respectively).

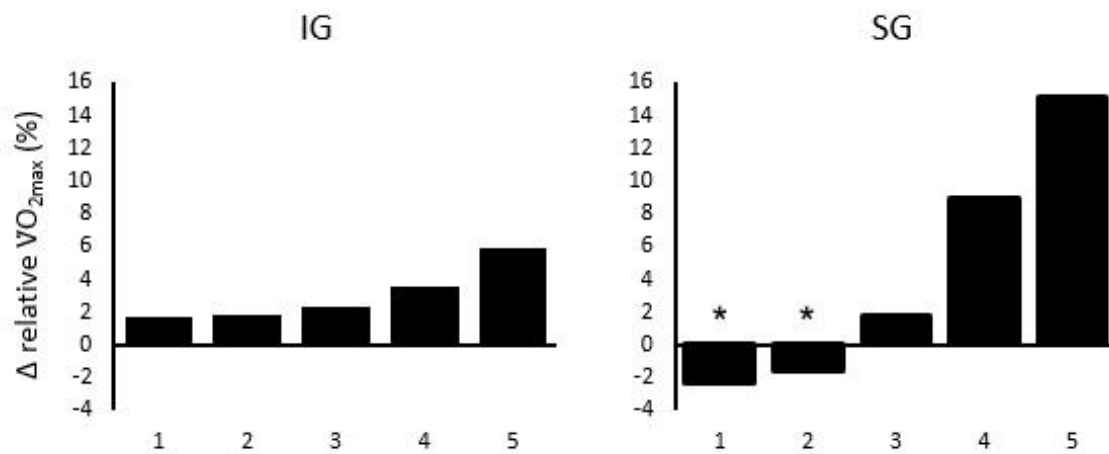


Figure 2 - Individual variability in relative  $\dot{V}O_{2max}$  response (% change) to 4 weeks of HIIT training prescribed in an individualized (IG) or standardized manner (SG). \*, adverse-responders ( $\Delta\dot{V}O_{2max} < 0\%$ ).

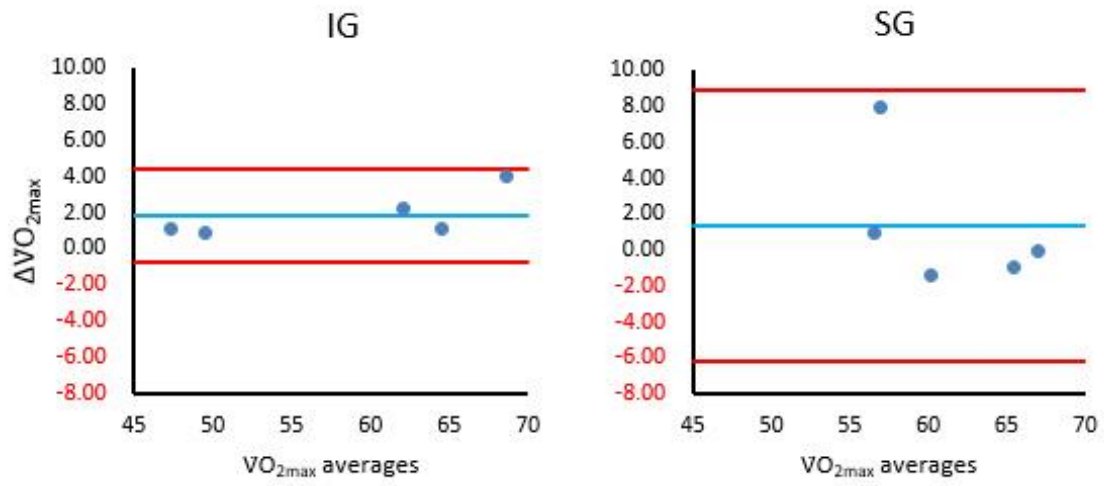


Figure 3 - Bland-Altman Plots. Blue line represents mean change, with red lines representing 95% CI.