

Abstract

# The effects of augmented feedback on twenty-five-kilometer cycling time trials on trained cyclists

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## 1. Background

In a sporting context, the objective of feedback is to enhance athletes' knowledge of their performance in conjunction with a performance target (Walchli et al, 2016). To facilitate this athletes have increasingly utilized augmented feedback (AF) such as heart rate and power during both training and events; a practice that has increased over the last few years due to the improved access to wearable technology (Puleo & Abraham, 2018). However, it is unknown if this feedback significantly increases the performance of the cyclist.

## 2. Purpose

To examine the physiological and psychological effect in the provision of AF on trained cyclists in a self-selected pace twenty-five-kilometer time trial.

## 3. Methods

Ten amateur cyclists volunteered to participate in this study (age  $42.0 \pm 6.3$  years, body mass  $77.9 \pm 8.1$  kg, height  $178.7 \pm 4.3$  cm,  $VO_{2max}$   $54.7 \pm 8.7$  ml kg<sup>-1</sup> min<sup>-1</sup>,  $VO_{2peak}$   $4.9 \pm 0.6$  l/min, HCT  $44.5 \pm 3.5$  %), with more than 2 years of time trial experience. Cyclists participated in three trials that were predetermined - Trial 1 ( $VO_{2max}$  and familiarization), Trial 2 (Time Trial with control conditions, only distance feedback visible) and Trial 3 (Time Trial with experimental

conditions). For the experimental time trial the following metrics were visible; heart rate (bpm), distance (meters), cadence (rpm), watts (average, peak, power to weight ratio), time (mins:secs), pedaling effectiveness score (PES) using WattBike Expert Software version 2.60.20. In addition, cyclists were provided a  $VO_{2max}$  report, 48 hours prior to the control trial).

During trial 1 an initial cycle incremental maximal ramp  $VO_{2max}$  protocol was conducted and measurements of blood lactate concentration (Bla) was collected to identify fixed lactate concentration thresholds (2 and 4 mmol) and associated heart rate (bpm) and power (watts). Trial 2 and 3 consisted of a twenty-five-kilometer cycling time trial conducted under two separate conditions (control and experimental). Throughout both time trials, measurement of Oxygen uptake ( $VO_{2}$ ) and galvanic skin response (GSR) was continually sampled along with lactate concentration (Bla), heart rate (bpm), power output (watts) and perceived exertion (RPE) at set distance intervals (every 5km). In addition, to clarify if the AF was being used, each participant was asked for confirmation of this.

## 4. Results

Results displayed no overall significant difference between control ( $38.37 \pm 2.04$  mins:secs) and experimental ( $38.34 \pm 1.68$  mins:secs) conditions in time taken



to complete the trial ( $p = 0.97$ ), speed ( $p = 1.00$ ), mean power ( $p = 0.80$ ) and cadence ( $p = 0.76$ ). There were no reported significant differences in respiratory or blood measurements however, the experimental trial reported a significantly ( $p = 0.01$ ) slower time (0.12mins:secs) to complete the initial 5km compared to the control trial. In comparison, although deemed non-significant ( $p > 0.05$ ) the control trial reported a quicker time (0.21mins:secs) to complete the final 5km of the time trial compared to the experimental trial. These results highlight the alterations in pacing strategies when cyclists are exposed to AF in cycling time trials. Each participant confirmed utilization of AF.

## 5. Discussion

The inclusion of AF altered pacing strategies between conditions (control and experimental) as reported by the differences in time to complete the initial 5km (0.12mins:secs) and final 5km (0.21mins:secs). This suggests an inefficient use of the data provided and could originate from an inability to filter relevant and irrelevant information to make informed decisions (Vatar *et al*, 2017). It also offers evidence of maintaining a reserve capacity which concurs with previous research in cycling time trials (Stone *et al*, 2017).

## 6. Conclusions

These results suggest that the implementation of AF to trained cyclists conducting a twenty-five-kilometer time trial does not elicit an overall significant performance enhancement. However, it is acknowledged that AF does alter performance and future research should focus upon the qualitative perspective of this investigation to clearly identify decision making processes in pacing strategies.