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

N Thompson[1] and Lee Waters[2]

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 utilised 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.

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

Methods: Ten amateur cyclists volunteered to participate in this study (age 42.0 ± 6.3years, body mass 77.9 ± 8.1 kg, height 178.7 ± 4.3 cm, VO_2max 54.7 ± 8.7 ml·kg·min-1, VO_2peak 4.9 ± 0.6 l/min, HCT 44.5 ± 3.5 %), with more than 2 years of time trial experience. Cyclists participated in three trials that were predetermined - Trial 1 (VO_2max and familiarisation), 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 (metres), cadence (rpm), watts (average, peak, power to weight ratio), time (mins:secs), pedalling 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_2 max 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-kilometre 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.

Results: Results displayed no overall significant difference between control (38.37±2.04mins:secs) and experimental (38.34±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 utilisation of AF.

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).

Conclusions: These results suggest that the implementation of AF to trained cyclists conducting a twenty-five-kilometre 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.