Brief Report

Affective feelings and perceived exertion during a 10-km time trial and head-to-head running race

Abstract

Purpose:

Our aim was to verify the affective feelings (AF) and rating of perceived exertion (RPE) responses during a 10-km competitive head-to-head (HTH) and compare it to a time-trial (TT) running race.

Methods:

Fourteen male runners completed 2 x 10-km runs (TT and HTH) on different days. Speed, RPE and AF were measured every 400-m. For pacing analysis races were divided into four stages: I) first 400 m (F400); II) 401m to 5000m (M1); III) 5001m and 9600m (M2) and; IV) the last 400m (final sprint [FS]).

Results:

Improvement of performance was observed (39:32 ± 02:41 min:s vs 40:28 ± 02:55 min:s; p = 0.03; ES = - 0.32) in HTH compared to TT. There were not differences in either pacing strategy or RPE between conditions. AF were higher during the HTH, being different in M2 when compared to TT (2.09 ± 1.81 vs 0.22 ± 2.25; p = 0.02; ES = 0.84).

Conclusion:

AF are directly influenced by the presence of opponents during a HTH race and a more positive AF could be involved in the dissociation between RPE and running speed and consequently, the overall race performance.

Keywords: Endurance, performance, strategy, behavior, decision-making

Introduction

Pacing strategy has been defined as the athlete's adjustment of the exercise intensity during a race[1] and seems to be controlled by a complex intuitive/deliberate decision-making process[2] influenced by physiological, psychological, environmental and tactical factors [2,3].

The rating of perceived exertion (RPE) has been considered an important factor in pacing adjustments, where athletes control the exercise intensity to reach the highest values of RPE at the end of the race[3-5]. However, during a race athletes experience multiple perceptual responses[3] and assuming that RPE is the only factor for explaining pacing strategy is an oversimplification of a complex process. Therefore, other psychological factors such as the construction of affect have an important role in exercise intensity[3,5].

Affective feelings (AF) of pleasure–displeasure involve interpretations of mood and emotions experienced by the individual in a given situation[6]. While RPE represents how athletes feel, AF represent what they feel[6]. In addition, AF will be generated by the athlete’s perception of performance in relation to their goals and expectations[3].

AF-pacing relationship has been observed during time-trial races[5,7] where the goal is to achieve the best time possible or in a well-controlled laboratory and against virtual opponents[8] where the effects of external influences as a position in the pack, environmental factor and opponents behavior are less predominant than a real head-to-head race[9]. In addition, AF-pacing relationship could be different when incorporating human-environment interactions. Casado et al.[10] verified AF in a real human-environment interaction during athletes' training routine and observed that in session performed collectively the metabolic strain and RPE were lower and AF were higher compared to a session performed individually. However, this study had a collaborative rather than the competitive nature, which can have an important impact on the results. Therefore, the aim of the study was to verify AF and RPE responses during a 10-km competitive head-to-head running race situation and compare them to time-trial running.

Methods

Participants

Fourteen trained male runners (33.3 ± 6.1 yrs, 69.5 ± 9.1 kg, 172 ± 8 cm, 56.7 ± 6.2 $ml \cdot kg^{-1} \cdot min^{-1}$), with at least 2 years’ experience and able to run 10 km in less than 45 minutes participated in the study. The study was approved by the local Ethics Committee according to the Declaration of Helsinki and each volunteer signed a written informed-consent form after receiving an explanation of the experimental procedures, possible risks, and benefits.

Experimental procedures

After familiarization sessions participants completed three experimental sessions separated by at least 144 hours. During the first session, all of them performed an incremental maximal exercise test to assess their maximal oxygen uptake (VO2max; Quark b^2, Cosmed, Rome, Italy). The second and third experimental sessions were performed in a random order but at same time of the day (±2h). The runners performed 2 x 10-km runs, one of them being a time-trial (TT) and the other a head-to-head (HTH) 10-km run. The TT was performed with one athlete at a time on the track. In the HTH all of the athletes (n=14) were positioned on the same start line. The running time was determined with a manual stopwatch (Hs-70w-1df, Casio, Tokyo, Japan) and prior to running participants were always instructed to attempt to achieve their best performance possible (best time or best position possible).

They were free to choose their own pacing strategy and constantly updated on the distance covered throughout the runs. Average speed, RPE (Borg's 6-20 Scale) and affective feelings (AF; feelings scale) were collected at every lap (400-m). Small scales were fixed to athlete's forearms to allow consultation when necessary. During HTH sessions each athlete was assigned to a researcher who was responsible for collecting the information at each lap. In all sessions participants were instructed to refrain from any exhaustive or unaccustomed exercise for at least 48h and they were instructed to avoid the consumption of caffeine or any other stimulants during the 24h period prior to the experimental sessions.

Statistical analysis

All values are presented as means ± standard deviation (SD). A paired t-test was used to compare race time between conditions. For the analysis of pacing, RPE, and AF, the 10-km race was divided into four stages: I) first 400 m (F400); II) between 401 m and 5000 m (M1); III) between 5001 m and 9600 m (M2) and; IV) the last 400m (final sprint [FS]). Average speed, RPE and AF were analyzed by a two-way repeated measures ANOVA followed by a post hoc of Tukey. The effect size (ES) was calculated and interpreted by using values of 0.2, 0.6, 1.2, 2.0 and 4.0 of the variation as thresholds for small, moderate, large, very large, and extremely large[11]. Statistical significance level was set at the $p \leq 0.05$. All statistical analyses were conducted using the SAS® statistical package (version 9.3, Cary, USA).

Results

From the 14 participants who started the race, eleven runners completed the HTH race and their data was used for the statistical analysis.

A small but significant improvement of 2.3% was observed in performance when HTH was compared to TT (39:32 ± 02:41 min:s vs 40:28 ± 02:55 min:s; $p = 0.03$; ES = - 0.32).

In both conditions athletes performed a classical "U-shaped" pacing strategy[1] without differences in relative average speed between conditions in any race stage (Figure 1A). In the same way, there were no differences between conditions in RPE, which increased linearly during both races (Figure 1B). During the TT, AF decreased progressively during the race reaching the lowest values in FS (0.16 ± 3.12). On the other hand, AF were higher during HTH (Figure 1C), with a significant difference and moderate effect size between conditions observed only in M2 (HTH = 2.09 ± 1.81 vs TT = 0.22 ± 2.25; $p = 0.02$; ES = 0.84).

Insert FIGURE 1

A great individual variation in relative average speed was observed when TT and HTH were compared. RPE seems to have been less influenced by the presence of opponents while a great individual variation was observed in AF responses throughout the race when comparing TT and HTH (FIGURE 2).

Insert FIGURE 2

Discussion

These findings show that while RPE was slightly affected by the opponent's presence, AF were higher during HTH. RPE increased progressively throughout the 10-

km in both conditions, which shows that athletes adjust the effort according to the distance to be covered and its pattern hardly changes[4,5].

Performance was improved in HTH condition, which is not novel[9], while the pacing strategy did not change. The better performance in HTH can be attributed to small increases in average speed during the race, which suggests a possible dissociation between RPE and running speed, at least in part, explained by differences in AF[3,5]. In fact, positive AF has been associated with higher speeds when compared to negative ones[3,5,7].

Since AF are related to physiological stress[5], results from HTH may have been affected by drafting[12] and the effects of running in group[10]. Casado et al.[10] reported lower RPE and blood lactate during their group training session. However, the effects of drafting on energy-saving are more noticeable at higher speeds than those observed in the present study[10,12]. Additionally, Casado et al.[10] study was performed at a more collaborative than competitive environment, which alters the decision-making process and the relationship of AF against goals and expectations[3]

During a TT, the goal is simpler (to achieve the best time possible) and success is self-referenced[7]. The attentional focus is internal and AF can be associated to exercise intensity and RPE, which explains why AF decrease whereas RPE increases in TT. Conversely, in HTH goal setting is crossing the finish line ahead of the opponents and the athlete–environment interaction changes the attentional focus from internal to external aspects[13]. This should be deduced in the data of the three participants who dropped out of HTH. The moment they dropped out of the HTH they reported similar RPE to that of the TT (athlete 1 = 16 vs 17; athlete 2 = 15 vs 14; athlete 3 = 8 vs 7), but they experienced more negative AF (athlete 1 = -5 vs 0; athlete 2 = -5 vs -2; athlete 3 = -5 vs -2) which could be associated to lower motivation and goal expectation. Considering the similarity between RPE and the reduced AF, it is conceivable that these participants dropped out as a consequence of negative feelings, and not due to a physiological failure, in a decision-making based on expectations, risks and rewards. However, this was an observational study and we did not attempt to directly manipulate AF. Future studies should be developed with AF as a variable of interest to provide a better understanding of its influence on decision-making and pacing strategy during middle/long distance races.

Practical Applications

Maintaining high levels of AF seems to influence performance positively in long-distance running races. Therefore, strategies related to goal setting should be developed with athletes to change their attention focus and expectations of success during races.

Conclusions

AF are directly influenced by the presence of opponents during a HTH race and a more positive AF would be involved in the dissociation between RPE and running speed and consequently, the overall race performance.

Acknowledgments

The authors thank the participants of the study and all of the researches involved in the data collection

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

1. Abbiss CR, Laursen PB. Describing and understanding pacing strategies during athletic competition. *Sports Med.* 2008;38(3):239-252.
2. Renfree A, Martin L, Micklewright D, St Clair Gibson A. Application of decision-making theory to the regulation of muscular work rate during self-paced competitive endurance activity. *Sports Med.* 2014;44(2):147-158.
3. Baron B, Moullan F, Deruelle F, Noakes TD. The role of emotions on pacing strategies and performance in middle and long duration sport events. *Br J Sports Med.* 2011;45(6):511-517.
4. Noakes TD. Linear relationship between the perception of effort and the duration of constant load exercise that remains. *J Appl Physiol.* 2004;96(4):1571-1573.
5. Renfree A, West J, Corbett M, Rhoden C, St Clair Gibson A. Complex interplay between determinants of pacing and performance during 20-km cycle time trials. *Int J Sports Physiol Perform.* 2012;7(2):121-129.
6. Hardy CJ, Rejeski WJ. Not what, but how one feels: The measurement of affect during exercise. *J Sport Exerc Psychol.* 1989;11(3):304-317.
7. Jones HS, Williams EL, Marchant D, et al. Distance-dependent association of affect with pacing strategy in cycling time trials. *Med Sci Sports Exerc.* 2015;47(4):825-832.
8. Williams EL, Jones HS, Sparks SA, et al. Deceptive Manipulation of Competitive Starting Strategies Influences Subsequent Pacing, Physiological Status, and Perceptual Responses during Cycling Time Trials. *Front Physiol.* 2016;7:536.
9. Corbett J, Barwood MJ, Ouzounoglou A, Thelwell R, Dicks M. Influence of competition on performance and pacing during cycling exercise. *Med Sci Sports Exerc.* 2012;44(3):509-515.
10. Casado A, Moreno-Pérez D, Larrosa M, Renfree A. Different psychophysiological responses to a high-intensity repetition session performed alone or in a group by elite middle-distance runners. *Eur J Sport Sci.* 2019:1-8.
11. Hopkins W, Marshall S, Batterham A, Hanin J. Progressive statistics for studies in sports medicine and exercise science. *Med Sci Sports Exerc.* 2009;41(1):3.
12. Pugh LGCE. Oxygen intake in track and treadmill running with observations on the effect of air resistance. *J Physiol.* 1970;207(3):823-835.
13. Hettinga FJ, Konings MJ, Pepping GJ. The Science of Racing against Opponents: Affordance Competition and the Regulation of Exercise Intensity in Head-to-Head Competition. *Front Physiol.* 2017;8:118.

Figure captions

FIGURE 1. Relative average speed (A), RPE (B) and AF (C) during TT and HTH races. TT = time-trial; HTH = head-to-head; dotted lines divide the races stages. * $p < 0.05$ between TT and HTH.

FIGURE 2. Individual values for relative average speed (A), RPE (B) and AF (C) during TT and HTH races by races stages.

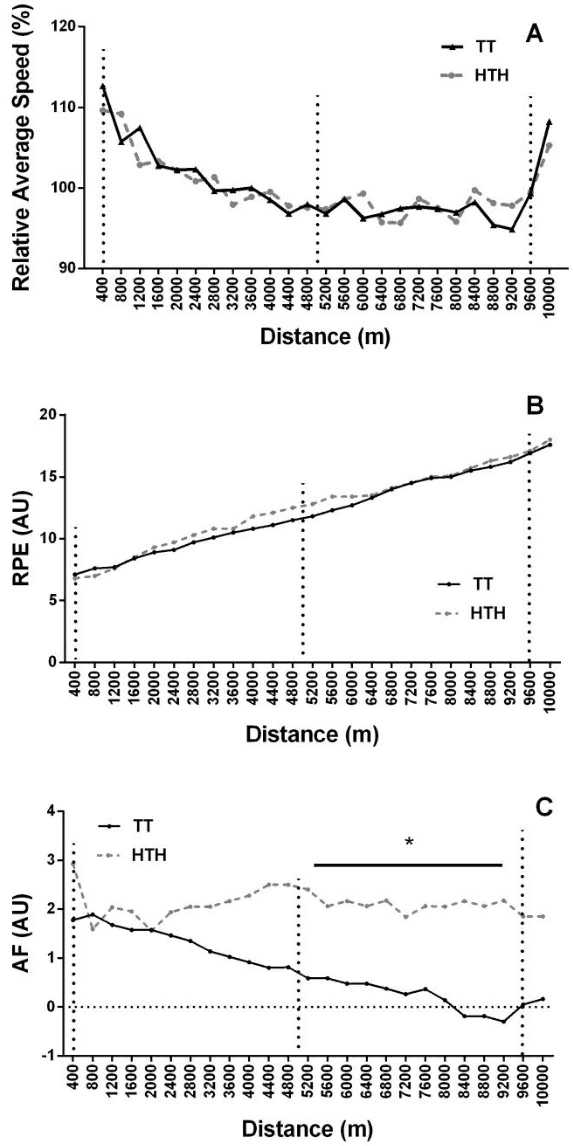

FIGURE 1. Relative average speed (A), RPE (B) and AF (C) during TT and HTH races. TT = time-trial; HTH = head-to-head; dotted lines divide the races stages. * $p < 0.05$ between TT and HTH.

135x258mm (300 x 300 DPI)

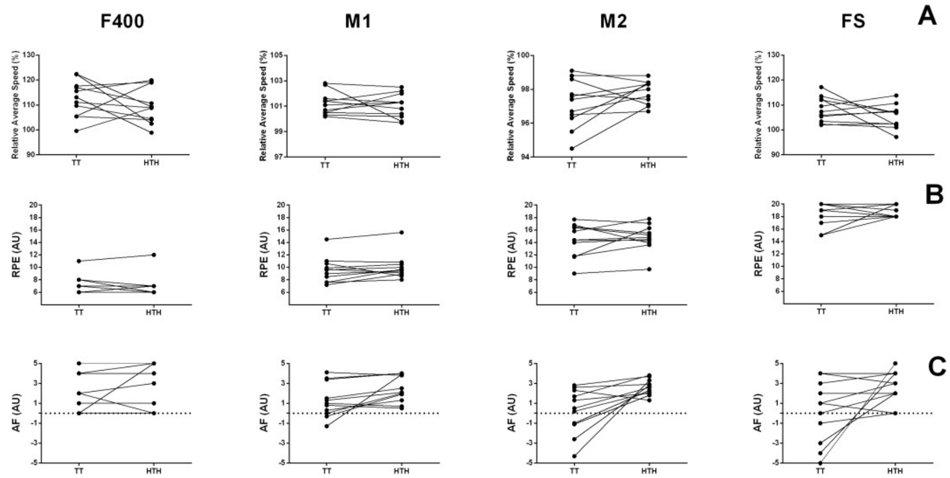

FIGURE 2. Individual values for relative average speed (A), RPE (B) and AF (C) during TT and HTH races by races stages.

258x132mm (300 x 300 DPI)