Evidence That the Talk Test Can Be Used to Regulate Exercise Intensity

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Abstract

Woltmann, ML, Foster, C, Porcari, JP, Camic, CL, Dodge, C, Haible, S, and Mikat, RP. Evidence that the talk test can be used to regulate exercise intensity. *J Strength Cond Res* 29(5): 1248–1254, 2015—The Talk Test (TT) has been shown to be a surrogate of the ventilatory threshold and to be a viable alternative to standard methods of prescribing exercise training intensity. The TT has also been shown to be responsive to manipulations known to change physiologic function including blood donation and training. Whether the TT can be used independently to regulated training intensity is not known. Physically active volunteers ($N = 16$) performed an incremental exercise test to identify stages of the TT (Last Positive [LP], Equivocal [EQ], and Negative [NEG]). In subsequent, randomly ordered, 30-minute steady-state runs, the running velocity was regulated solely by "clamping" the TT response desired and then monitoring the response of conventional markers of exercise intensity (heart rate, blood lactate, rating of perceived exertion). All subjects were able to complete the LP stage, but only 13 of 16 and 2 of 16 subjects were able to complete the EQ and NEG stages, respectively. Physiologic responses were broadly within those predicted from the incremental exercise test and within the appropriate range of physiologic responses for exercise training. Thus, in addition to correlating with convenient physiological markers, the TT can be used proactively to guide exercise training intensity. The LP stage produced training intensities compatible with appropriate training intensity in healthy adults and with recovery sessions or long duration training sessions in athletes. The EQ and NEG stages produced intensities compatible with higher intensity training in athletes. The results demonstrate that the TT can be used as a primary method to control exercise training intensity.

Key Words exercise prescription, training intensity, exercise training

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Introduction

Based on evidence from controlled training studies, exercise prescription is usually based on information derived from maximal exercise testing (percentages of heart rate reserve [HRR], oxygen uptake reserve [$\dot{V}O_2max$], or peak power output) (1). In athletes, rather than target heart rate (HR), training intensity is often determined from speeds defined during time trials or competitions (5,13). However, >35 years ago, Katch et al. (14) pointed out the limitations of the "relative percent concept." This suggestion has been supported more recently (24). Recent evidence suggests that concepts based on metabolic thresholds (ventilatory threshold [VT], lactate threshold [LT], respiratory compensation threshold [RCT], and maximal lactate steady state [MLSS]) may be superior as anchors for training prescription (3,7,17,25). However, since maximal exercise test results or competitive race performance are not always available, there has been recent interest in subjective methods of measuring exercise intensity such as the rating of perceived exertion (RPE) (8,19) and the Talk Test (TT) (4,6,9–11,15,16,18,20–23,26,27). The RPE scale has been used widely (cf. 8) and is well-accepted as a guide exercise training (8,19). The TT is a broad construct related to the ability to "speak comfortably" in response to any of a number of speech provoking strategies (responding to questions, reciting a standard paragraph, counting out loud, hearing yourself breathe). It works apparently because the increase in breathing frequency at the VT and RCT is incompatible with the need to suppress breathing frequency during vocalized speech. The concept of the TT has been around since 1939, when Professor Grayson in the United Kingdom advised mountaineers to "climb no faster than you can speak." Systematic study of the TT as a tool for exercise prescription has been ongoing in a number of laboratories since the late 1990s (3,6,15,18,21,23,27). The validity of the TT as a marker of exercise intensity has been demonstrated in a variety of populations including clinical (4,16,26,27), sedentary (10), and athletic/physically active individuals (6,10,11,20,22,23) based largely on correlative studies. During incremental exercise, the Last Positive (LP) stage of the TT (the last stage at which the subject can definitely speak comfortably) is typically just below the intensity of the VT (6). The Equivocal (EQ) stage (the first time that the subject equivocates about their ability to speak comfortably) approximates the intensity of the VT. Similarly, the first Negative (NEG) stage (the first time the subject is definitely sure they cannot speak comfortably) is associated with the intensity of the RCT (22,23). However, these studies have largely been correlative, in which responses of the TT have been evaluated compared with physiological responses during incremental exercise. Although these data are very suggestive of the potential of the TT as a tool for guiding exercise training intensity, there is little evidence for how well the TT "translates" from incremental to steady-state training. In particular, we are aware of no evidence that directly demonstrates that simply giving advice to exercise in relation to TT markers can produce predictable and desirable responses during exercise training.

Recent studies (9–11) have suggested that TT results obtained during incremental exercise can be "translated" into steady-state training intensities, by picking either the LP-1 (the stage before the LP stage) or LP stages in physically active individuals, the LP-1 stage in sedentary individuals, or the LP-1 or LP-2 stages in patients in rehabilitation programs (16). However, in these studies, the TT status often changed across the duration of a training bout. In a more practical sense, it would be desirable to know whether telling an exerciser to maintain a constant TT response would serve as a tool for guiding them into the right exercise intensity. Thus, if "clamping" the TT response (e.g., always being within one of the TT defined zones) was practical, then the need to control exercise training intensities into specific running speed, or to monitor HR or [HLa] responses, might become unnecessary. Guiding athletes into the right training intensities might then be very much easier, but just as accurate. This poses the question for this study; can defining training intensity zones be as simple as clamping the talk test status? Accordingly, the purpose of this study was to compare physiologic responses during a steady-state exercise bout with the TT response clamped with the subject always being able to talk comfortably (e.g., positive TT), in the equivocal (EQ) zone, or with the subject definitely not able to speak comfortably (NEG). This strategy should provide a practical test of whether the large amount of inferential data suggesting that the TT can identify metabolic thresholds is likely to work at a practical level. The study hypotheses were that (a) in the POS TT bout, exercise intensity would be less than the LT. This would mean that [HLa] would be constant at near resting values, that RPE would be relatively moderate (~3–4), that HR would be within conventionally accepted values for exercise prescription in trained individuals, and that all subjects would be able to finish a 30-minute bout; (b) that in the EQ TT bout, exercise intensity would approximate the MLSS. This would mean that the [HLa] would stabilize at values ~4 mmol·l^{-1} range, that HR would be near the upper limit of conventionally accepted values for exercise prescription (e.g., 60–85% HRR), that RPE would be in the "hard" range (~4–6), and that most subjects would be able to finish the 30-minute bout; and (c) in the NEG TT bout, exercise intensity would be greater than the MLSS. This would mean that [HLa] would progressively increase, that HR would be >85% maximal HRR, that RPE would be in the "very hard" range (~7–9), and that most subject would not complete a 30-minute bout. This stage would define intensities typically used for interval training in athletes (5,13).

Methods

Experimental Approach to the Problem

This was an observational study of psychophysiologic response markers (HR, [HLa], and RPE) during training runs, nominally of 30-minute duration, in which the controlled variable was the TT response. The TT response was assessed and the running speed was manipulated every 2 minutes so that the TT response remained within 1 of 3 response zones (positive, EQ, or NEG). The training runs were all conducted in the laboratory on a motor driven treadmill with well-controlled environmental conditions (temperature = 19–22° C).

Subjects

The subjects were healthy well-trained volunteers ($N = 16$) aged 19–26 (Table 1). Some were members of National Collegiate Athletic Association Division 3 sports teams (soccer [$n = 2$], track and field [$n = 3$]), but for the most part, they were not high-level competitive athletes. However, all were training ≥5 hours per week, and most competed regularly in

Table 1. Descriptive statistics of the subjects.*†

Subjects	Age (y)	Height (cm)	Weight (kg)	$\dot{V}O_2$max (mL·kg^{-1}·min^{-1})	$\dot{V}O_2$ at VT (mL·kg^{-1}·min^{-1})	$\dot{V}O_2$ at RCT (mL·kg^{-1}·min^{-1})
Men: 8	21.6 ± 1.4	179.8 ± 5.7	77.6 ± 10.9	60.2 ± 7.2	41.2 ± 9.7	48.0 ± 7.5
Women: 8	22.8 ± 1.7	168.4 ± 6.2	66.2 ± 7.1	49.7 ± 4.8	33.8 ± 5.9	42.6 ± 6.7

*Values are mean ± *SD*.
†VT = ventilatory threshold; RCT = respiratory compensation threshold.

5–20 km road races. Before commencement of the study, all subjects were screened with the Physical Activity Readiness Questionnaire (PAR-Q) to identify contraindications to participation. The aims, procedures, and risks of the study were explained, and each subject provided voluntary written informed consent. The study protocol had been approved by the university human subjects committee. Review and consent procedures follow the principles outlined in the Declaration of Helsinki.

Procedures

Each subject performed 2 incremental exercise tests on a motorized treadmill with a constant 1% grade (12): (a) with measurement of respiratory gas exchange to measure VT, RCT, and $\dot{V}O_2max$; and (b) without respiratory gas exchange, to allow measurement of TT responses. During the incremental test with the TT, after 1.5 minutes of each 2-minute stage, the subject recited the "Pledge of Allegiance" as a speech provoking stimulus (9–11,26) and responded to the question "can you speak comfortably?" Their response options were constrained to "yes, I can speak comfortably" (POS), "yes, I can speak, but not entirely comfortably" (EQ), and "no, I cannot speak comfortably" (NEG). The fastest speed at which they provided positive answer was designated as the Last Positive (LP). The first speed at which their response was equivocal was designated as EQ, and the first (e.g., slowest) speed with a negative TT response was designated as the NEG.

Based on the results of each subject's maximal incremental test with TT responses, we predetermined the speed at which each subject should begin their steady-state runs, representing the running speed at the LP, EQ, and NEG stages during the incremental test. The speed was adjusted every 2 minutes to maintain the clamped TT response. Specifically, if the subject was running at their LP velocity, they were expected to be able to talk comfortably throughout the trial. If they did not respond positively at the end of a given segment, then the speed was decreased by 0.1 mph (0.04 $m \cdot s^{-1}$). This was continued at each 2-minute segment until the subject gave the appropriate (e.g., POS response). Similarly, in the run intended to be NEG, if the subject could speak, either comfortably (POS) or with some difficulty (EQ), the speed was increased by 0.1 mph (0.04 $m \cdot s^{-1}$) until the subject gave a NEG response to the TT challenge. The order of the tests was randomized, and there were at least 48 hours between tests.

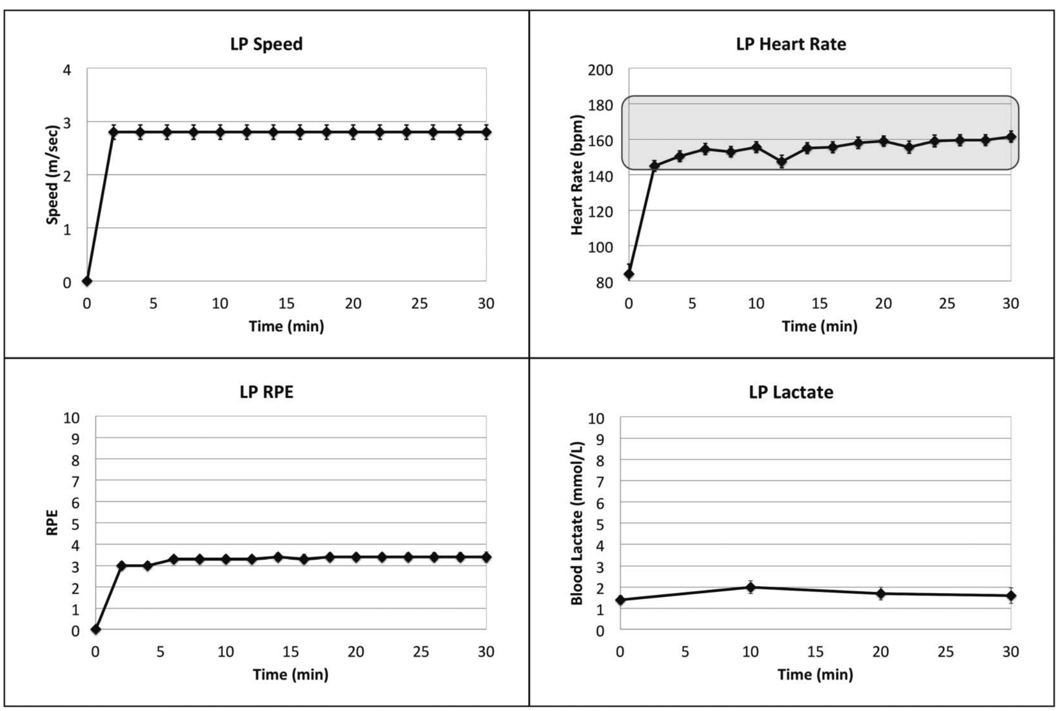

Figure 1. Mean (bold lines) and individual (thin lines) responses of speed, HR, RPE, and [HLa] during steady-state runs at the LP TT intensity (identified during the incremental exercise test). Only very small changes in running speed were required to allow TT responses to be "clamped" at the POS stage. HR, RPE, and [HLa] responses were consistent with conventionally accepted intensities for training in healthy individuals (1). HR = heart rate; RPE = rating of perceived exertion; LP = Last Positive; TT = Talk Test.

Each test began with a standard warm-up of 5-minute walking/jogging. In the maximal tests, the velocity was increased to 4.5 mph (2.01 $m \cdot s^{-1}$) for 2 minutes and incremented by 0.5 mph (0.22 $m \cdot s^{-1}$) every 2 minutes until the subject could not continue. On separate days, the subjects performed 4 treadmill runs of 30-minute duration or until exhaustion if 30 minutes could not be completed. After the 5-minute walking/jogging warm-up, the starting speed of each run was equal to the speed of the LP, EQ, and NEG stages from the incremental test. After 1.5 minutes of each subsequent 2-minute segment, the subject repeated the standard speech provoking stimulus, and the speed was adjusted to keep the TT responses clamped at the desired intensity. Speed, HR by radio telemetry, RPE (Category Ratio scale (2)), and TT responses were measured during the last 30 seconds of every 2-minute segment of the 30-minute run. Blood lactate concentration [HLa] was recorded at 0, 10, 20, and 30 minutes (or at exhaustion if the subject could not continue) using dry chemistry (Lactate Plus; www.lactate.com). Blood [HLa] measurements were taken by having the subject straddle the treadmill belt for ~15 seconds to allow for blood sampling. After the measurement was completed, the subject continued their run. Test time was not paused for the lactate measurement because all were obtained within 15 seconds, and we reasoned that the energy cost of getting back on the treadmill was at least equivalent to continuing to run.

Statistical Analyses

The data were analyzed using repeated measures analysis of variance for an exercise intensity (stages of the TT) by duration design. Statistical significance was accepted when $p \leq 0.05$. Post hoc analyses were performed using Tukey's HSD.

Results

The results of the steady-state run at the LP (e.g., POS TT) exercise intensity are presented in Figure 1. All subjects were able to complete the run, and there were very small changes (usually decreases) in running speed required to maintain the ability to speak comfortably. Measured values for speed, HR, RPE, and [HLa] remained relatively constant across the 30-minute time trial. The shaded areas of the HR graph represent American College of Sports Medicine (ACSM's) recommendations for %HRR during exercise for healthy adults (60–85%) (1), which were achieved throughout the entire 30-minute exercise bout. The RPE response during

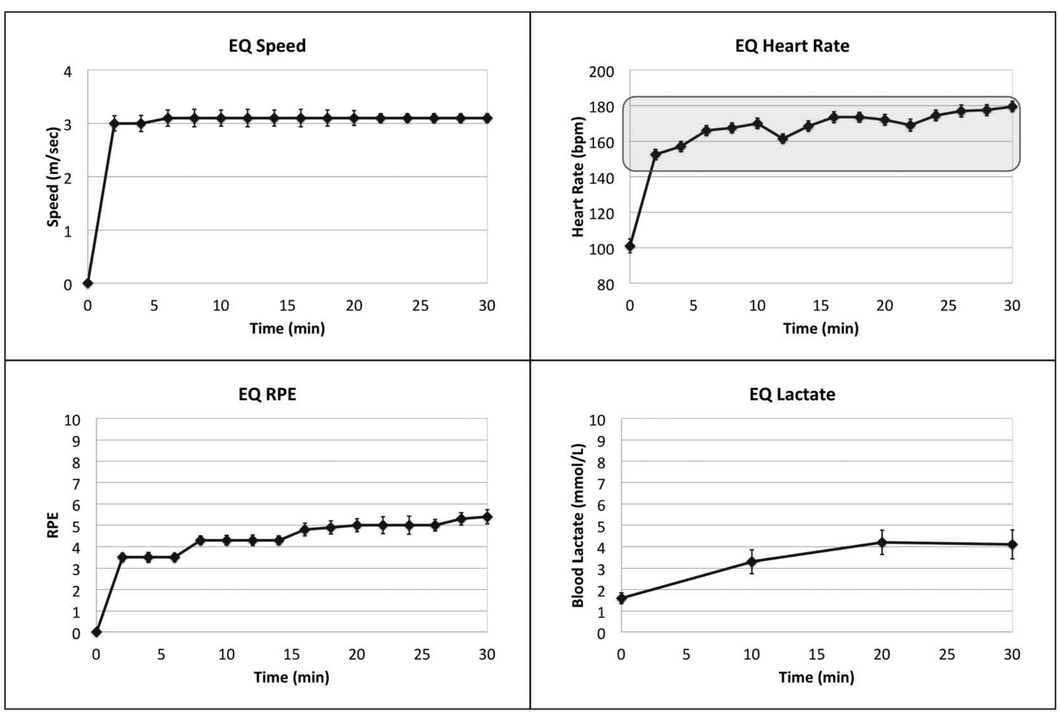

Figure 2. Mean (bold lines) and individual (thin lines) responses of speed, HR, RPE, and [HLa] during steady-state runs at the EQ TT intensity (identified during the incremental exercise test). Only 13 of 16 subjects could complete the 30-minute steady-state bout. Frequent small changes in velocity were required to "clamp" the TT response at this level. Responses of HR, RPE, and [HLa] are consistent with running at intensities very close to the MLSS in athletes. HR = heart rate; RPE = rating of perceived exertion; EQ = Equivocal; TT = Talk Test; MLSS = maximal lactate steady state.

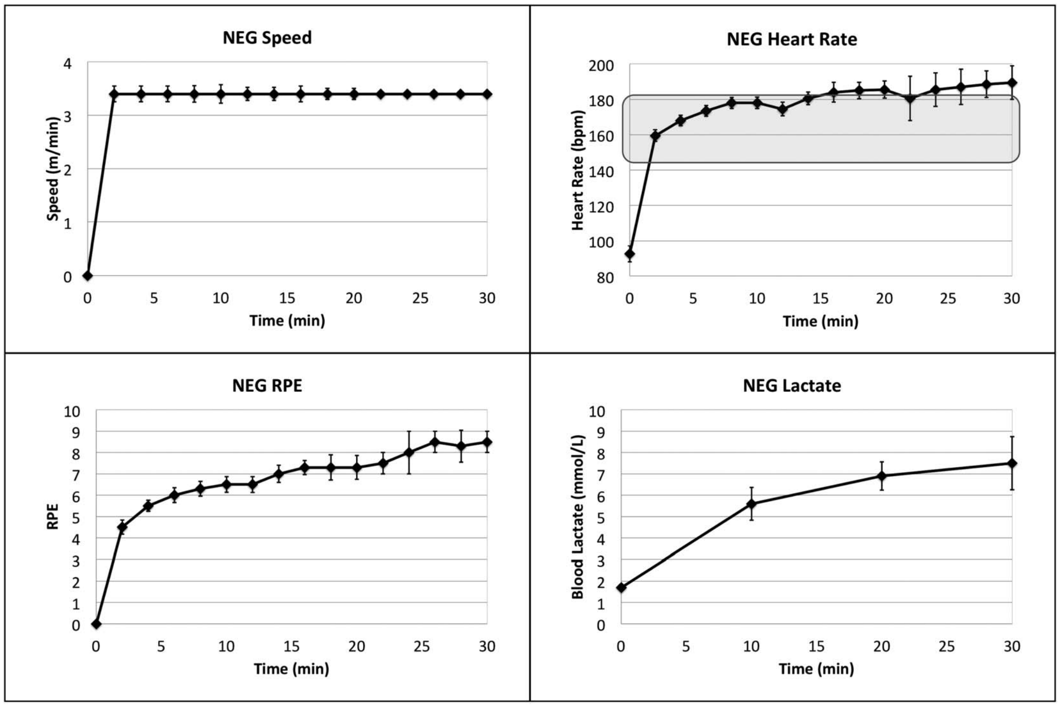

Figure 3. Mean (bold lines) and individual (thin lines) responses of speed, HR, RPE, and [HLa] during steady-state runs at the NEG TT intensity (identified during the incremental exercise test). Only 2 of 16 subjects could complete the 30-minute steady-state bout. Responses of HR, RPE, and [HLa] were consistent with a running intensity > MLSS, in the "severe" intensity domain (13). HR = heart rate; RPE = rating of perceived exertion; NEG = Negative; TT = Talk Test; MLSS = maximal lactate steady state.

the LP run, similar to the HR, did not deviate much across the 30-minute time trial and remained in the "moderate" (RPE ~3) range throughout the exercise bout. Blood [HLa] showed the same pattern, remaining relatively constant across the 30 minutes at near resting values.

Steady-state conditions were not achieved during either the TT EQ (Figure 2) or TT NEG (Figure 3) stages. Not all subjects were able to successfully complete 30 minutes of either the EQ ($n = 13$ of 16, mean duration = 27.5 ± 10 minutes) and NEG ($n = 2$ of 16, mean duration = 14.5 ± 1.5 minutes) runs, respectively. The EQ run required frequent small speed changes suggesting that there is a very narrow "window" of exercise intensity that represents the EQ exercise stage. As a general finding, the starting speed, based on the EQ stage of the incremental test, was too hard and quickly led to the inability to speak comfortably (e.g., a NEG response). However, even a small reduction in running speed led to a POS response, hence the need to frequently change running speed.

The HR responses during the EQ and NEG bouts were different than the HR responses in the LP bouts. The initial HR was higher and less stable across the "30 minute" in both the EQ and NEG stage runs, with a substantial degree of cardiovascular drift. The HR was generally above the range recommended by ACSM for exercise training intensity in healthy individuals by the conclusion of the run (1). Similarly, RPE was higher and continued to rise throughout the "30 minute" in both EQ and NEG exercise bouts. Blood [HLa] during the EQ and NEG bouts also supported our hypothesis as [HLa] began at higher values and continued to rise throughout the 30-minute bouts. In the EQ run, the [HLa] eventually stabilized by the end of 30 minutes, suggesting that this intensity approximated MLSS. In many regards, this intensity is comparable with the "threshold runs" often recommended by athletics coaches (5). In the NEG exercise bout, [HLa] continued to rise throughout the entire exercise bout. The combined observations support our hypotheses that (a) by clamping the TT response at an intensity associated with the EQ stage, exercise intensity would be approximately equal to MLSS, and (b) clamping the TT response at an intensity associated with the NEG stage, exercise intensity would be greater than MLSS.

Discussion

The main finding of this study was that predictable physiologic responses, defining well-accepted training zones (7,13,25) could be achieved, based solely on the instruction to the subjects to regulate exercise intensity relative to their ability to speak comfortably. When the TT was clamped at the LP intensity (e.g., the subjects could always speak comfortably), steady-state conditions were achieved based on speed, HR, RPE, and [HLa]. The average HR achieved during the LP runs was within ACSM recommendations for exercise intensity in trained individuals (60–85% HRR), RPE remained in the moderate range, and [HLa] remained near resting values. Generally, clamping the TT response at the highest intensity which allowed comfortable speech was associated with fully steady-state exercise responses. These data support the implications from the largely correlative studies relating the TT to physiologic responses. Although there has been considerable interest in the value of high intensity training during the last several years, the best evidence suggests that endurance athletes do the majority (70–90%) of their training at intensities below the VT/LT (7,25). The present data suggest that the ability to speak comfortably (e.g., TT POS) is associated with this training intensity zone. This suggests that, without requiring that HR or [HLa] be directly measured, an appropriate training zone for either recovery runs or long duration runs can be defined solely through TT responses.

There was no evidence of fully steady-state conditions in EQ and NEG. Not all of the 16 subjects were able to complete EQ (13 of 16) and NEG (2 of 16). All 4 variables (speed, HR, RPE, and [HLa]) during EQ were higher than during the LP bout and demonstrated considerable drift. The values in NEG were even higher, and less stable, than in EQ. The HR during EQ was within ACSM guidelines until approximately 25 minutes into the run but exceeded 85% HRR by 30 minutes. During NEG, HR exceeded the recommended 85% HRR throughout most of the 30-minute bout. The runs with the NEG TT results are likely above the intensity of the MLSS. This means that they are also likely at an intensity greater than the critical power (CP) (13), which suggests that the NEG TT intensity represents an intensity between the RCT/MLSS/CP and $\dot{V}O_2$max, which is widely accepted as appropriate for "aerobic intervals" (5,25), which serves as the basis for much of the interval training accomplished by endurance athletes. Thus, in addition to specifically addressing the intensity of steady-state runs, the results of this study suggest the utility of TT responses to defining how interval training is conducted.

It seems that athletes must do at least some of their training at intensities ≥ MLSS (5,7,25), in the so-called "severe" intensity domain (13) where metabolic disturbances may be profound but may also lead to large and specific training responses. Having a very simple marker of exercise intensity (NEG) presents a very simple and practical option for those athletes unable to measure HR or [HLa]. Similarly, the value of "threshold runs" is widely appreciated by athletics coaches as a device for improving running performance (5). The EQ intensity seems to identify this intensity zone, also without the necessity for direct measurement of either HR or [HLa].

The TT has been shown to work more or less the same with both running and cycling (20), so it seems reasonable to suggest that it is a very robust measurement, not requiring retesting to (for example) define a unique training HR zones.

Practical Applications

The data suggest that TT, which has largely been studied during incremental exercise, is not only a simple and promising but is a highly useful technique for prescribing and regulating exercise training intensity. TT responses (POS, EQ, and NEG) accurately reflected exercise intensities below, at/near, and above the VT/LT/RCT/MLSS/CP, which are anchor points for the control of training, particularly in endurance athletes. The practical lessons that can be taken from this study are as follows:

- If the ability to speak comfortably is maintained, exercise intensity is within broad HR, blood lactate, and RPE parameters for steady-state aerobic training.
- If the ability to speak comfortably is EQ (e.g., I can speak, but not entirely comfortably), then the broad HR, blood lactate, and RPE parameters for training at the MLSS or CP are likely satisfied.
- If comfortable speech is clearly absent, then the intensity of exercise is likely above the MLSS or CP and is likely in the range appropriate for "aerobic interval training."

Thus, the current data demonstrate the practical utility of using an exquisitely simple monitoring tool, the ability to speak comfortably, to regulate and control exercise training intensity. These data fulfill the promise evident in earlier literature based primarily on incremental exercise (4,6,9–11,15,16,20–23,26,27) about the practical value of the TT.

Acknowledgments

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