Relationship Between the Talk Test and Ventilatory Threshold

Mehgan Dehart-Beverley, Carl Foster, John P. Porcari, Dennis C.W. Fater, Richard P. Mikat

La Crosse Exercise and Health Program, University of Wisconsin-La Crosse, La Crosse, WI 54601

Abstract

Purpose: The Talk Test is widely recommended for prescribing exercise; however, few studies have evaluated its validity. This study evaluated the relationship between the Talk Test and ventilatory threshold.

Methods: Healthy volunteers (n = 28) completed two maximal exercise tests, one with gas analysis to identify ventilatory threshold (VT), the other without. During the second test, subjects read a standard paragraph during each stage (the Rainbow Passage) and reported whether or not they "passed" the Talk Test (i.e., could talk comfortably). Outcomes at VT and the last positive (+), positive/negative (±), and negative (-) stages of the Talk Test were compared.

Results: There was a significant ($p < .05$) difference between $\dot{V}O_2$ at VT and at the + stage of the Talk Test (37.5 vs. 35.4 mL · min^{-1} · kg^{-1}), % $\dot{V}O_2$peak (80 vs. 75%), HR (169 vs. 161 bpm), and % HRpeak (90 vs. 85%). There was no significant difference between any of the variables at VT and the ± stage (37.1 mL · min^{-1} · kg^{-1}, 79% $\dot{V}O_2$peak, 166 bpm, 88% HRpeak). There was a significant difference between all the outcomes at VT and the - stage of the Talk Test (40.6 mL · min^{-1} · kg^{-1}, 87% $\dot{V}O_2$peak, 174 bpm, 92% HRpeak). These results are supported by regression analysis, which demonstrated that the relationship between the $\dot{V}O_2$ at VT and the $\dot{V}O_2$ at ± was virtually identical with the line of identity, while the relationship between $\dot{V}O_2$ at VT and $\dot{V}O_2$ at + and at - were below and above the line of identity, respectively.

Conclusions: When subjects could either talk comfortably or were equivocal, they were at or below their VT. Subjects clearly failing the Talk Test were consistently beyond their VT. Thus, the Talk Test may be a valid subjective measure to guide exercise prescription.

Key Words: *exercise prescription, exercise training*

A frequently recommended subjective method of regulating exercise intensity is the Talk Test (1-3). The Talk Test is a subjective measure that asks the participant to exercise at the highest intensity possible that still allows them to respond comfortably in conversation. Although widely recommended to the public, few studies have examined the relationship between the Talk Test and objective measures of exercise intensity. Thus, the recommendation to use the Talk Test represents an unexamined assumption in clinical exercise physiology. In 1995, Brawner, Keteyian, and Czaplicki (4) and, in 1997, Czaplicki, Keteyian, Brawner and Weingarten (5) reported that ACSM's exercise intensity guidelines of 60–90% of $\dot{V}O_2$max were generally met when subjects responded to a tape-recorded interview designed to elicit speech and be an index of the Talk Test. Beyond this, there are no studies relating the Talk Test to objective markers of exercise intensity. The Talk Test should be related to the ventilatory threshold (VT) since high levels of ventilatory control are necessary for reasonably normal speech, and the drive to increase ventilatory frequency (Vf) above the VT (6, 7) would mitigate against high levels of ventilatory control. Accordingly, it seems reasonable to hypothesize that the Talk Test would be highly related to objective measures of exercise intensity such as the VT. The purpose of this investigation was to provide a test for this hypothesis.

Methods

Twenty-eight subjects (14 male and 14 female) provided informed consent and volunteered to participate in this study. Both male and female subjects were used to increase the applicability of the results. Their descriptive data are presented separately in Table 1 to better appreciate the characteristics of the subjects. However, since there was no gender-related hypothesis for this study, the subjects were treated as a single group for analytical purposes. All subjects were regular exercisers, and all participants completed a health history questionnaire (8) with negative results. The study was approved by the Institutional Review Board at the University of Wisconsin-La Crosse.

Address for correspondence: Carl Foster, PhD, Department of Exercise and Sport Science, University of Wisconsin-La Crosse, La Crosse, WI 54601.

© 2000, Human Kinetics, Clinical Exercise Physiology, 2(1), 34–38

Table 1
Descriptive Physical Characteristics of the Subjects (Mean ± Standard Deviation)

Variable	Men (n = 14)	Women (n = 14)	Total (n = 28)
Age (yr)	23.4 ± 4.5	24.8 ± 7.4	24.1 ± 6.1
Height (cm)	178.3 ± 4.4	167.1 ± 5.2	172.7± 7.4
Weight (kg)	76.2 ± 9.0	67.0 ± 9.4	71.6 ± 10.2
$\dot{V}O_2$peak (ml · kg^{-1} · min^{-1})	52.6 ± 3.8	40.4 ± 8.1	46.5 ± 8.8
% Predicted $\dot{V}O_2$peak	111.9 ± 7.2	104.6 ± 18.2	108.2 ± 14.1
$\dot{V}O_2$ at VT (mL · kg^{-1} · min^{-1})	42.7 ± 3.3	32.4 ± 8.0	37.5 ± 8.0
% $\dot{V}O_2$peak at VT	80.3 ± 6.9	79.5 ± 7.0	79.9 ± 6.8
HRpeak (b · min^{-1})	192.3 ± 7.6	184.9 ± 14.5	188.6 ± 12.0
HR at VT (b · min^{-1})	173.4 ± 9.5	165.4 ± 18.5	169.4 ± 15.0
% HRpeak at VT	90.2 ± 4.2	89.3 ± 5.6	89.8 ± 4.9

Table 2
Means (± Standard Deviation) of Outcome Variables at VT, Last Positive, Positive/Negative, and Negative Responses During the Talk Test

Variable	@ VT	@ Last +	@ ±	@ –
$\dot{V}O_2$ (mL · kg^{-1} · min^{-1})	37.5 ± 8.0	35.4 ± 9.4*	37.1 ± 9.3	40.6 ± 9.4*
% $\dot{V}O_2$peak	80.3 ± 6.1	75.4 ± 9.5*	79.1 ± 9.9	87.0 ± 8.0*
HR (b · min^{-1})	169 ± 15	161 ± 20*	166 ± 19	174 ± 16*
% HRpeak	89 ± 5	85 ± 8*	88 ± 7	92 ± 6*
$\dot{V}_E$ (L · min^{-1})	74.3 ± 22.2	70.1 ± 25.6	73.9 ± 26.4	85.6 ± 29.0*
% $\dot{V}_E$peak	67 ± 9	62 ± 11	66 ± 12	76 ± 12*
Vf	37.4 ± 7.0	36.8 ± 7.4	37.1 ± 7.8	39.6 ± 8.3*
% Vfpeak	80 ± 10	79 ± 9	79 ± 9	84 ± 8*
RPE	5.6 ± 1.3	5.2 ± 1.6	5.8 ± 1.6	7.2 ± 1.7*

*Indicates significant difference ($p < 0.0167$) vs. @ VT.

Each subject performed two maximal exercise tests, in random order, separated by no more than 2 weeks. Balke or Åstrand treadmill exercise protocols with 2-min stages were used depending on the subject's exercise habits. If the subject was a walker, they were tested using a Balke protocol (velocity = 1.56 m · s^{-1}). Joggers and runners were tested using an Åstrand protocol (velocity = 2.23 m · s^{-1} or 3.13 m · s^{-1}, depending on their running ability). One of the two tests was conducted using continuous measurement of respiratory gas exchange using open circuit spirometry (Quinton QMC, Seattle, WA). VT was identified using the V slope method (9). HR was assessed using radiotelemetry, and RPE was assessed using the category ratio scale of Borg (10) during each 2-min stage. The

other test was conducted in an identical manner but without gas analysis. This test identified when the participants could no longer comfortably (by their own estimation) speak the words of a standard paragraph (Talk Test). During the last minute of each stage of the test, the subjects read "the Rainbow Passage," a widely used standard passage in clinical speech pathology (15). Then they were asked, "can you still talk comfortably?" They answered "yes" (meaning they could still speak reasonably comfortably), "I'm not sure", or "no" (meaning they could not speak reasonably comfortably). These answers were coded as +, ±, and –.

Differences between the physiologic responses at the VT and three indicators of the Talk Test were compared using repeated measures ANOVA to compare main effects of $\dot{V}O_2$, HR, $\dot{V}_E$, Vf, and RPE at the repeated measures of +, ± and – stages in relation to the talk test with the same outcome measures at VT. The Scheffe procedure was used to make pairwise comparisons when justified. As a supportive analysis, the regression of $\dot{V}O_2$ at VT versus the $\dot{V}O_2$ at the +, ±, and – stages of the Talk Test was computed.

Results

Descriptive statistics of the subjects are presented in Table 1 and are consistent with a young and well conditioned population. The men were slightly more fit than the women, but both groups were more highly fit than average for age and gender (14, 16). The % $\dot{V}O_2$peak at VT and % HRpeak at VT was consistent for all groups.

The mean values (± standard deviation) for the outcome variables are presented in Table 2. Oxygen consumption, % $\dot{V}O_2$peak, HR, and % HRpeak at VT were significantly ($p < .05$) higher compared to the last positive stage of the Talk Test. There were no significant differences for $\dot{V}_E$, % $\dot{V}_E$peak, Vf, % Vfpeak, RPE, and time at the same stage.

There were no significant differences between any of the variables at VT and the ± stage of the Talk Test. There were significant positive correlations between $\dot{V}O_2$, HR, $\dot{V}_E$, Vf, and RPE at VT and the same variables at the ± stage (r = 0.91, 0.84, 0.88, 0.90, and 0.63, respectively). At the negative stage of the Talk Test, the $\dot{V}O_2$, HR, $\dot{V}_E$, Vf, RPE, and time during the treadmill protocol were all significantly different than at VT. The regression between the $\dot{V}O_2$ at VT and the +, ± and – stages of the Talk Test demonstrate that the regression line is virtually identical with the line of identity for the ± stage (Figure 1). For the + and – stages of the Talk Test, the regression line is substantially parallel to the line of identity but offset by approximately ± 2–4 mL · kg⁻¹ · min⁻¹.

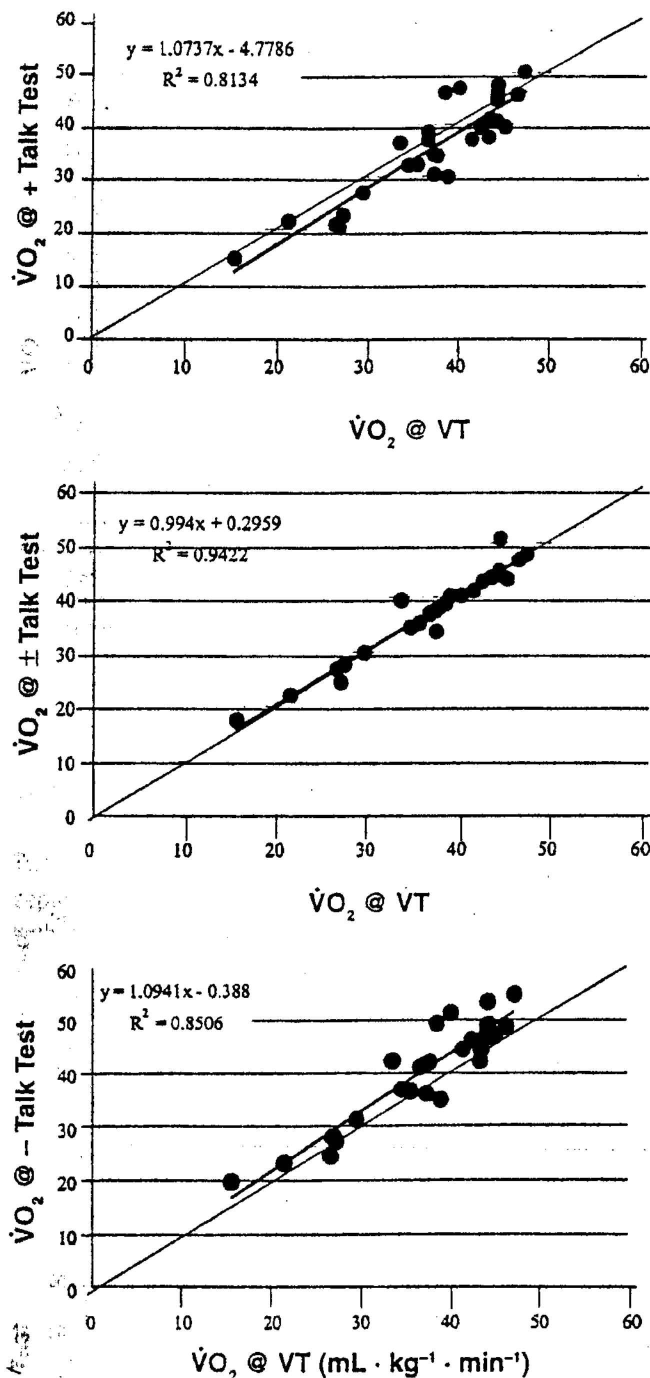


Figure 1 Regression between $\dot{V}O_2$ at VT and $\dot{V}O_2$ at the +, ± and – stages of the Talk Test. Notice the position of the regression line relative to the line of identity. During the ± stage, the regression line is not distinguishable from the line of identity.

Discussion

The purpose of this study was to test the hypothesis that the Talk Test represents a simple behavioral surrogate of the VT. The results support this hypothesis. The last time an individual can "pass" the Talk Test is usually just short of the VT, and the point at which they are uncertain whether or not they pass the Talk Test approximates fairly closely the VT. The point where the individual is no longer comfortable talking (i.e., they "fail" the Talk Test) is consistently associated with values beyond their VT.

Two previous studies analyzing the Talk Test (4, 5) found the Talk Test to be associated with responses consistent with well accepted principles of exercise prescription. This is in agreement with our findings, which indicate that the equivocal (±) stage of

the Talk Test is essentially equivalent to VT and that failing the Talk Test is consistently associated with responses greater than the VT. In addition, we found the last positive or equivocal stage of the Talk Test, on average, to be at 88% of HRpeak. This falls at the upper end of the ACSM's exercise intensity guidelines of 55–90% of HRpeak (11) and suggests that if an individual cannot talk comfortably, they are probably beyond the limits of acceptable levels of exercise intensity.

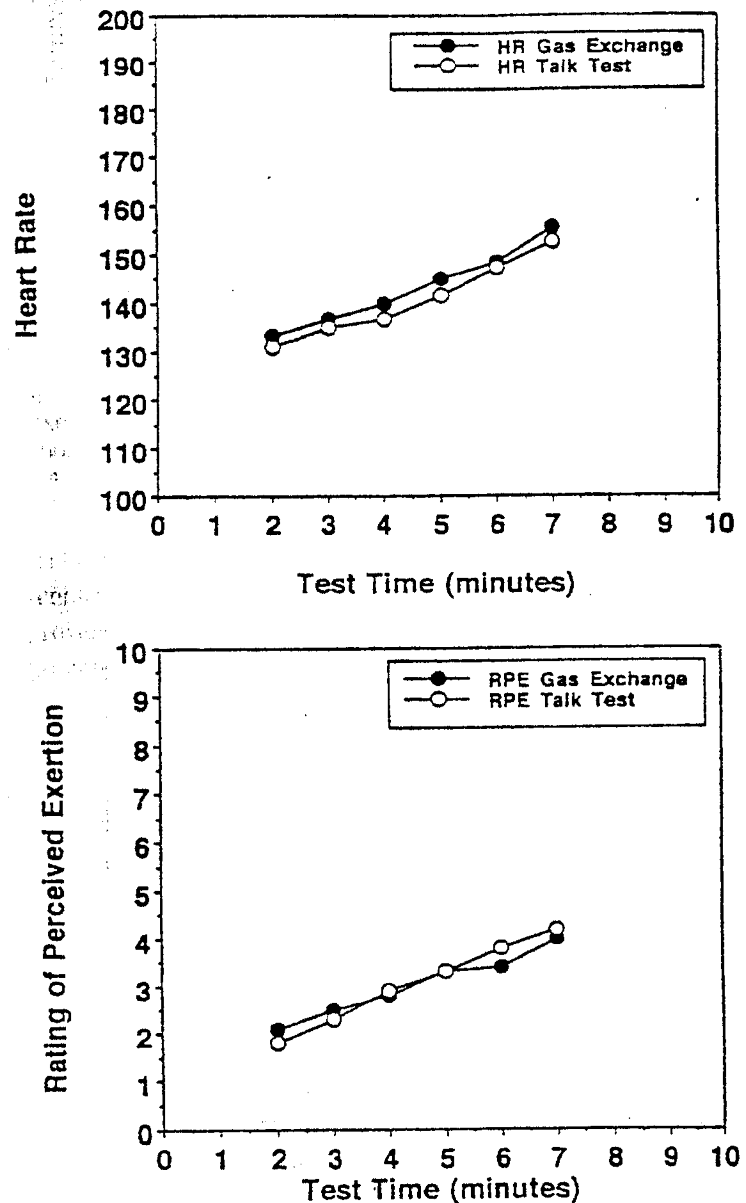
Meyer et al. (12) observed that the ventilatory threshold generally preceeded the ischemic threshold in patients with coronary artery disease. Although the mechanistic cause for these findings remains obscure, linkage of these results and our findings suggests that being able to pass the Talk Test would predict that a patient had not achieved their ischemic threshold. Given that cardiovascular complications during exercise training have been shown to be related to training above the ischemic threshold (13), it may be that exercising patients at a level where conversation is still possible would minimize the likelihood of cardiovascular complications during exercise.

There were several possible technical limitations of the study. First, the protocol chosen used 2-min stages. Ventilatory threshold is best obtained through shorter stages (14). In addition, analysis of Talk Test variable times were limited to 2-min intervals adversely affecting the temporal resolution of the relationships. Nonetheless, due to technical constraints during the Talk Test, the stage duration could be shortened no further. Second, we utilized a standard 101-word paragraph commonly used in clinical speech pathology to obtain a speech sample (15). This was a long passage, perhaps more extensive than would be commonly spoken during exercise. However, the benefits of the passage are that it is commonly used and forces all subjects to speak a standard amount. The last point is that the subjects included in the study were relatively young and fit. Their mean $\dot{V}O_2$peak was 108.2% of what was predicted (16, 17). Since the primary application of the Talk Test is to the sedentary public, the study needs to be replicated with sedentary subjects. Nevertheless, the present results are striking and suggest the value of this simple technique for regulating exercise intensity.

Concern that the nature of our Talk Test changed the physiologic variables we were trying to study stimulated analysis of HR and RPE between the two incremental tests. There were no physiologic differences of practical significance between the gas exchange and Talk Test (Figure 2). At matched times during the exercise protocol, both HR and RPE during the two tests were very similar and show that the Talk Test was no more difficult than the gas exchange maximal exercise test.

Clinical Implications

The results of this study suggest that the Talk Test can be used as a simple and practical surrogate of the ventilatory threshold. If the ventilatory threshold is taken as a reference point for exercise prescription, the observation that a participant can still comfortably talk suggests that the momentary exercise intensity is below the ventilatory threshold. Because of previous associations between the ventilatory threshold and the ischemic threshold, the talk test may provide a means for improving the safety of exercise training programs.



◆ Figure 2 Comparative responses of HR and RPE during the exercise tests with and without gas exchange measurements. These responses demonstrate that performing the Talk Test did not systematically influence the overall response to the exercise bout.

References

1. American College of Sports Medicine (1991). *Guidelines for Exercise Testing and Prescription* (4th ed.). Philadelphia: Lea & Febiger.

2. American Council on Exercise (1997). *A Walk a Day*. San Diego, CA: ACE Publishing.

3. Ornish D (1990). *Dr. Dean Ornish's Program for Reversing Heart Disease*. New York: Ballantine Books.

Brawner CA, Keteyian SJ, and Czaplicki TE (1995). A method of guiding exercise intensity: the talk test. *Med. Sci. Sports Exerc.* 27:S241.

. Czanlicki TE, Keteyian SJ, Brawner CA, and Weingarten MA (1997). Guiding ercise training intensity on a treadmill and dual-action bike using ue talk test. *Med. Sci. Sports Exerc.* 29:S70.

. Wasserman K (1984). The anaerobic threshold measurement in exercise testing. *Clin. Chest Med.* 5:77-88.

. Wasserman K, Whipp BJ, Koyal SN, and Beaver WL. (1973). Anaerobic threshold and respiratory gas exchange during exercise. *J. Appl. Physiol.* 35:236-243.

. Balady GJ, Chaitman B, Driscoll D, et al. (1998). Recommendations for cardiovascular screening, staffing, and emergency policies at health/fitness facilities. *Med. Sci. Sports Exerc.* 30:1009-1018.

. Schneider DA, Phillips SE, and Stoffolano S (1993). The simplified V-slope method of detecting the gas exchange threshold. *Med. Sci. Sports Exerc.* 25:1180-1184.

0. Borg GA, Hassman P, and Langerstrom M (1987). Perceived exertion related to heart rate and blood lactate during arm and leg exercise. *Eur. J. Appl. Physiol.* 65:679-685.

11. Pollock ML, Gaesser GA, Butcher JD, et al. (1998). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med. Sci. Sports Exerc.* 30:975-991.

12. Meyer K, Samek L, Pinchas A, Baier M, Betz P and Roskamm H (1995). Relationship between ventilatory threshold and onset of ischaemia in ECG during stress testing. *Eur. Heart J.* 16:623-630.

13. Hossack KF, Hartwig R (1982). Cardiac arrest associated with supervised cardiac rehabilitation. *J. Card. Rehabil.* 2:402-408.

14. Foster C, Schrager M, and Snyder AC (1995). Blood lactate and respiratory measurement of the capacity for sustained exercise. In: Maud PJ, Foster C, eds. *Physiological Assessment of Human Fitness*, pp. 57-67. Champaign, IL: Human Kinetics.

15. Fairbanks G (1960). *Voice and Articulation Drillbook* (2nd ed.). New York: Harper and Row.

16. Bruce RA, Kusumi F, and Hosmer D (1973). Maximal oxygen intake and nomographic assessment of functional aerobic impairment in cardiovascular disease. *Am. Heart J.* 85:546-562.

17. Drinkwater BL, Horvath SM, and Wells CL (1975). Aerobic power of females, ages 10-68. *J. Gerontol.* 30:385-394.