UNIVERSITY OF WISCONSIN-LA CROSSE

Graduate Studies

TRANSLATION OF THE TALK TEST TO EXERCISE PRESCRIPTION

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science

Elizabeth Jeanes

College of Science and Health
Clinical Exercise Physiology

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TRANSLATION OF THE TALK TEST TO EXERCISE PRESCRIPTION

By Elizabeth Jeanes

We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science, Clinical Exercise Physiology.

The candidate has completed the oral defense of the thesis.

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ABSTRACT

JEANES, E. Translation of the talk test to exercise prescription. MS in Clinical Exercise Physiology, December 2010, 41pp. (C. Foster)

In exercise prescription, intensity is the most difficult variable to define. Intensity is defined by $\%HR_{max}$ or % of maximal METS. An alternative method of measuring exercise intensity is the TT (Talk Test). The purpose of the current study was to determine how much of a reduction in absolute intensity from an incremental exercise test was needed to allow for comfortable speech during exercise training. Fourteen physically active subjects participated in the study. Subjects performed multiple incremental exercise tests and three 40-minute training bouts based on one stage before the Last Positive (LP-1), Last Positive (LP) or equivocal (EQ) TT. All training bouts resulted in $\%HR_{max}$ values within the recommend range of 64-94%. Training bouts based on the LP-1 and LP produced RPE values within the recommended guidelines of moderate to hard (3-5). The majority of subjects could speak comfortably when they trained at the exercise bout based on the LP-1 or LP TT. There was no significant difference between speed, heart rate or RPE at any matched stage of repeated incremental tests. This study concluded that in order for an individual to speak comfortable, the individual must work at an intensity no higher than their LP TT.

ACKNOWLEDGMENTS

Foremost I would like to express gratitude to my committee chairperson, Carl Foster. Your guidance, intellect and support made the concept of completing a thesis a less daunting process. I feel honored to have worked under your supervision.

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Finally, I'm appreciative of all of the relationships I've developed over the past year. To my classmates, LEHP participants and faculty, thank you for the support and friendship you have given me. Your presence in my life has made a lasting impression on my heart.

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INTRODUCTION

Of the four variables of the FITT principle (frequency, intensity, time, and type) that are used to prescribe exercise, intensity is the most difficult variable to define. According to the American College of Sports Medicine, individuals should work at an intensity of 64 to 94% of their maximum heart rate or 50-85% of their maximum METs (1,13). However, there are a few obstacles with these current definitions. First, both definitions require a maximal effort test. In order to perform a maximal exercise test, trained professionals and equipment must be present and a maximal test requires a physician in males over the age of 45 and females over 55 years of age. A maximal effort test may be compromised if handrail support is permitted as exercise tolerance may be overestimated (2). Second, the definitions of intensity use a very wide range of relative percent values; therefore it may not be clear exactly where, within the range, an individual should train. A number of years ago Katch et al. (10) challenged the fundamental validity of the relative percent concept. If a beginning exerciser chooses a heart rate or MET range that's too high the risk of complications during exercise is increased (8). The current guidelines also fail to define the absolute intensity (e.g. speed and grade of walking) although "translation" techniques are available (6).

An alternative method of measuring exercise intensity during submaximal exercise is the Talk Test. The Talk Test is a subjective measure of exercise intensity, which has been shown to be a reliable surrogate of ventilatory threshold in many

populations including healthy university students (5,12), well-trained athletes (14), and patients with cardiovascular disease (16). These studies suggest that individuals who can speak comfortably are working at an intensity below their ventilatory threshold. If they definitely cannot speak comfortably, they are likely above their respiratory compensation threshold. Individuals who are unsure whether or not they can speak comfortably are likely working at an intensity approximating their ventilatory threshold. The Talk Test has also been shown to be a marker of the ischemic threshold in individuals with exertional ischemia (4). This suggests that if patients work at an intensity where they can speak comfortably, their risk of exertional complications decreases. Meyer et al. (11) found similar results in a study which demonstrated that ventilatory threshold typically occurs before the ischemic threshold.

Foster et al. (7) determined that the Talk Test could track changes in ventilatory threshold. When ventilatory threshold was manipulated by either blood donation or training, causing a change in exercise intensity, the Talk Test responded appropriately. Foster et al. (6) showed that the exercise responses from a graded exercise test could be translated and used during exercise training in sedentary individuals. From this study it was found that the absolute intensity from a GXT could be defined from a submaximal exercise test to provoke a given HR response. A recent study looked at whether or not the absolute intensity could be translated from the intensity measured by the Talk Test during an incremental exercise test and used during submaximal exercise to elicit the appropriate training intensities in sedentary individuals (9). They found that there was about a 10% decrease in the absolute intensity in order for these individuals to be able to speak

comfortably during exercise training. A 10% decrease is absolute intensity was more or less equivalent to one stage below the intensity of the Last Positive stage of the Talk Test.

The purpose of the current study was to determine how much absolute training intensity needed to be decreased from the intensity during an incremental exercise test to elicit comfortable speech in physically active individuals. The hypothesis was that the absolute intensity would need to be decreased about 10% to allow comfortable speech in physically active individuals as well as provoke the appropriate HR, RPE or TT responses.

METHODS

Subjects

Fourteen physically active individuals (6 males and 8 females) participated in this study. Their descriptive characteristics are presented in Table 1. To be considered physically active they had to meet the current ACSM guidelines by participating in at least 30 minutes of moderate intensity exercise at least five days a week (1). The University of Wisconsin-La Crosse Institutional Review Board for the Protection of Human Subjects approved the protocol. Written informed consent was obtained from each subject before they participated.

Table 1. Descriptive characteristics (mean ± SD) of the subjects

	Males (N=6)	Females (N=8)	Total N=14
Age	20.5 ± 1.87	21.9 ± 1.96	21.3 ± 1.98
Height (cm)	180 ± 5.7	163 ± 6.7	170 ± 10.8
Weight (kg)	73.2 ± 7.03	57.4 ± 7.9	64.2 ± 10.90
VO_{2max} (O_2/kg)	56.0 ± 6.75	48.7 ± 4.53	51.8 ± 6.55
VO_2 @ VT	2.71 ± 0.51	2.03 ± 0.28	2.32 ± 0.52
HR_{max}	190 ± 8.02	191 ± 10.81	190 ± 9.37

Protocol

Each subject performed a total of 6 tests. The first test was an incremental exercise test on a treadmill until fatigue. During this test, respiratory gas exchange was measured using open circuit spirometry. From this data, ventilatory threshold was established using the V slope method (15). The subjects began with a ramped warm-up, walking at a constant speed of 3.0 mph and 1% grade. After 3 minutes, the treadmill speed increased to 4.0 mph and 5.0 mph in 2-minute increments. Once 5.0 mph was reached, the speed increased by .5 mph every 2 minutes until the subject reached volitional exhaustion. The grade remained constant at 1% for the entire test. Throughout the test, heart rate was measured by radiotelemetry and RPE was monitored by the Category Ratio Rating of Perceived Exertion scale (3).

The second test consisted of another incremental exercise test until fatigue. The same protocol was followed except that during this test the Talk Test was measured. In order to measure the Talk Test each subject recited a standard paragraph (The Pledge of Allegiance) during the last 30 seconds of each 2-minute stage. When they finished

reciting the paragraph, each subject was asked, "Can you speak comfortably?" The subject responded by answering 'yes', 'equivocal' or 'no'. The last time the subject responded with a "yes" was defined as the Last Positive (LP) stage. The first time the subject was unsure if they could speak comfortably was defined as the "equivocal" (EQ) stage. The speed achieved during the LP and EQ stages of the Talk Test were noted and used to determine the speeds of the three training bouts.

The subsequent tests consisted of 40-minute training bouts performed in random order. A minimum of 48 hours separated each training bout. Each test began with a ramped warm-up until the subject achieved either the stage before their Last Positive (LP-1) Talk Test, the stage at their LP Talk Test stage, or the stage of their EQ Talk Test. The speed and grade remained constant for rest of the 40-minute training bout. The subject recited the standard paragraph during the last 30 seconds of each 5-minute segment of the 40-minute test. After reciting the paragraph they were asked, "Can you speak comfortably?" Their responses were defined as follows: yes=1, equivocal=2 and no=3. Heart and RPE were monitored at the end of each 5-minute segment.

The final test consisted of a second incremental exercise test in which the Talk Test was measured, a test identical to the second test described above. This test was performed in order to test the reproducibility of the exercise responses (speed, heart rate and RPE) using the Talk Test.

Statistical Analysis

Repeated measures ANOVA was used to compare heart rate, RPE and Talk Test responses at 10, 20, 30, and 40 minutes of each training bout between intensities. To compare the reproducibility of speed, heart rate, and RPE between the first and second incremental exercise tests, repeated measure ANOVA was utilized. When statistically significant differences occurred ($p<.05$), the Tukey post-hoc test was used to identify where the significance differences lay.

RESULTS

The absolute and percent of maximal heart rate values of the three training sessions are displayed in Figure 1. Each training bout in which the speed was determined by the Talk Test responses from the incremental exercise test elicited heart rates within the recommended by the American College of Sports Medicine guidelines (64-94% of HR_{max}). However, during the last 10 minutes of the equivocal stage, the % of HR_{max} exceeded the upper limit of these guidelines. The heart rate values during the LP-1 stage of the Talk Test were stable by the end of the 40-minute run. On the other hand, the heart rate during the LP and EQ stages of the Talk Test continued to increase until the end of the LP and EQ stage. Heart rate drift occurred during all three steady state intensities. Heart rate values at 20, 30, and 40 minutes of the LP-1, LP and EQ sessions were significantly different from one another.

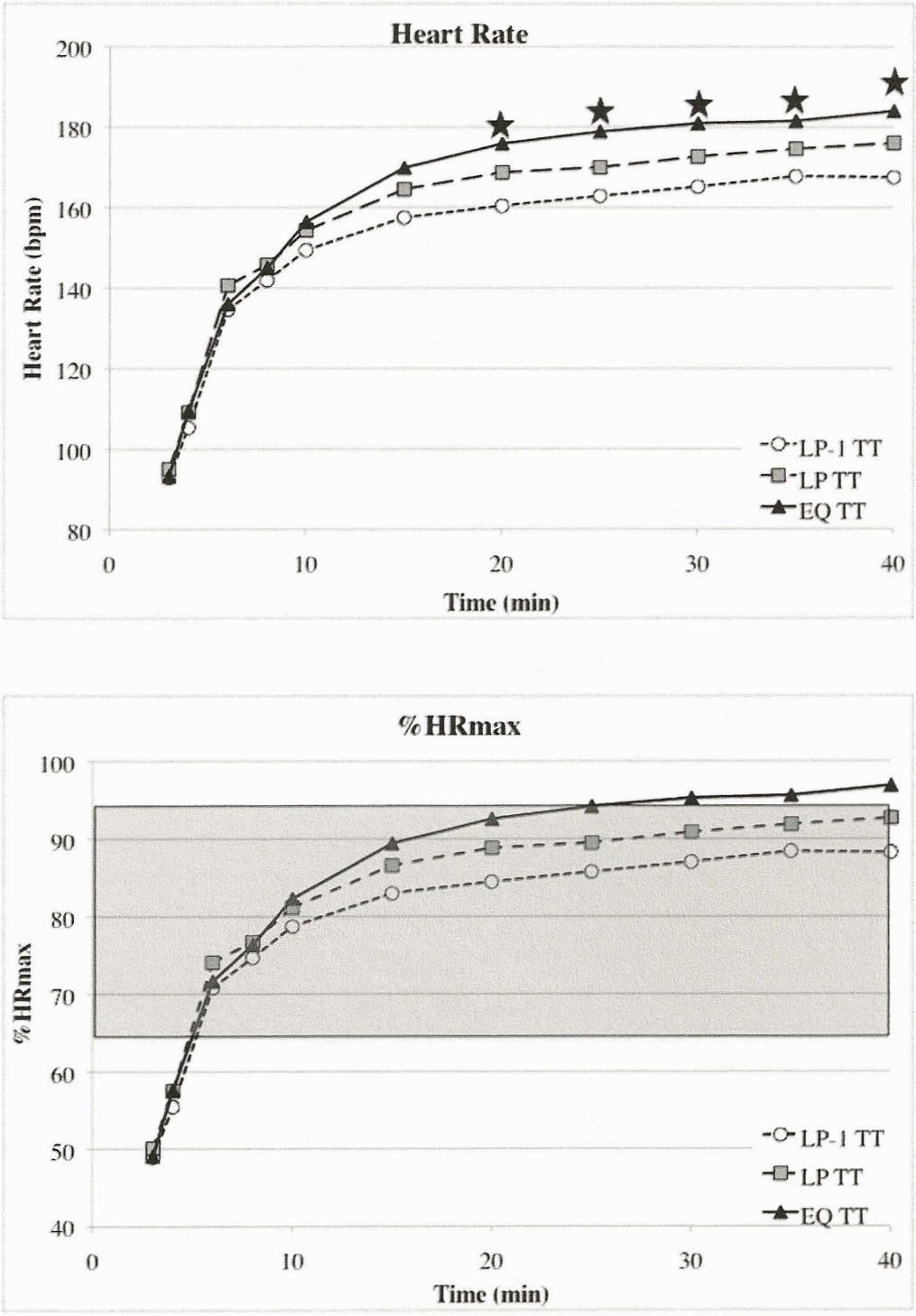


Figure 1. Absolute exercise intensity (Heart Rate) and relative exercise intensity ($\%HR_{max}$) responses during each 40-minute training bout. The shaded area in the $\%HR_{max}$ figure is representative of the recommended intensity (1).

The RPE during the three training bouts is presented in Figure 2. The training bout based on the LP-1 and LP stage of the Talk Test produced RPE values within the recommended range of moderate to hard (e.g. 3-5) intensity. However, the training bout based on the EQ stage of the Talk Test resulted in RPE values greater than the recommended range. RPE drift occurred during all three bouts. RPE values at 30 and 40 minutes during the LP-1, LP, and EQ intensities were significantly different from one another.

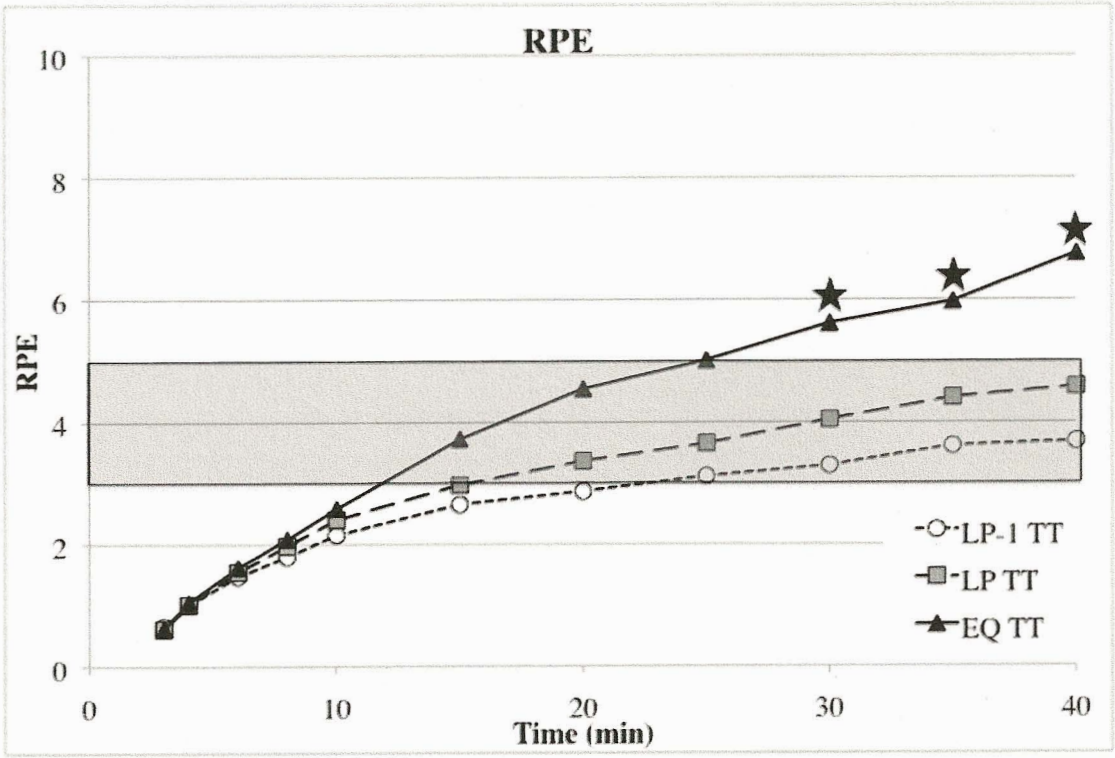


Figure 2. RPE responses during each training session. The shaded area represents the recommended intensity for RPE (1).

The Talk Test responses during each training session are presented in Figure 3. The sessions based on the LP-1 and LP stages of the Talk Test allowed most subjects to speak comfortably throughout the 40-minute training bouts. However subjects were beginning to have difficultly speaking comfortably by the end of the 40 minutes. Subjects were unsure whether or not they could speak comfortably half way through the training bout based on the EQ stage of the Talk Test. By the end of the run most subjects could not speak comfortably. Talk Test responses from the LP-1 and LP stage at 20, 30, and 40 minutes were significantly different from the EQ stage, but not significantly different from one another.

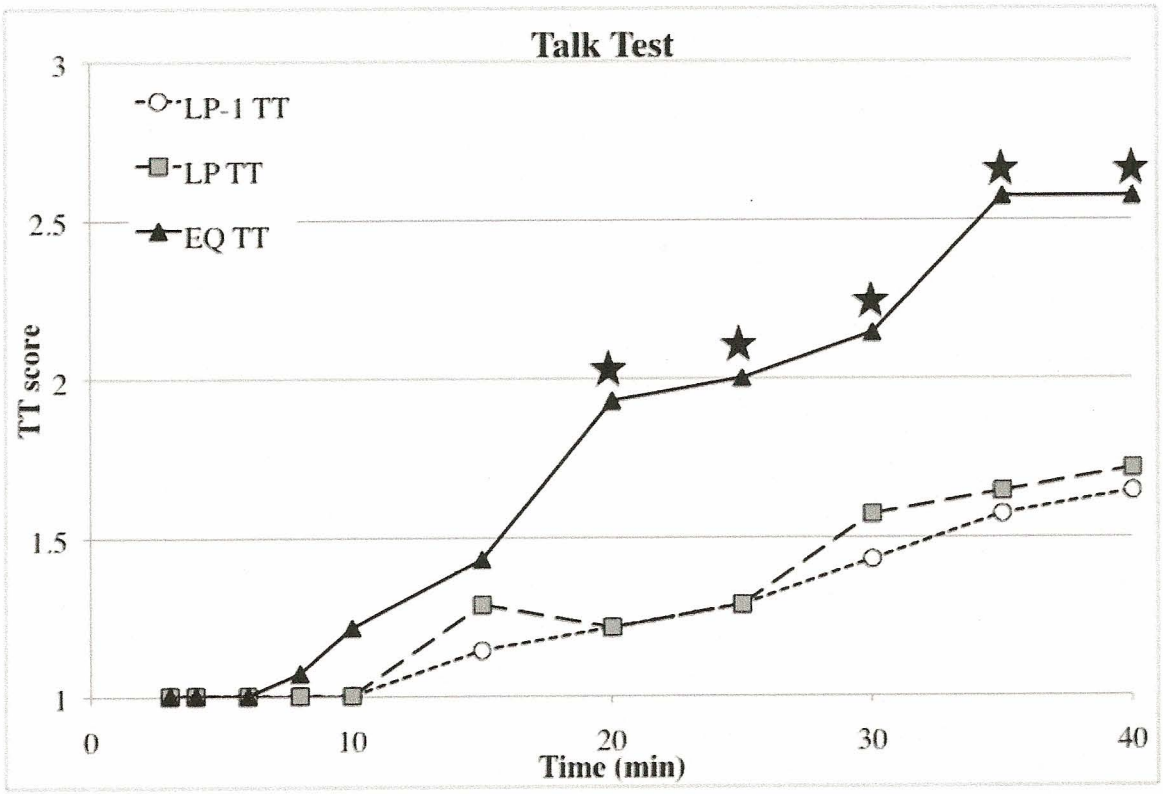


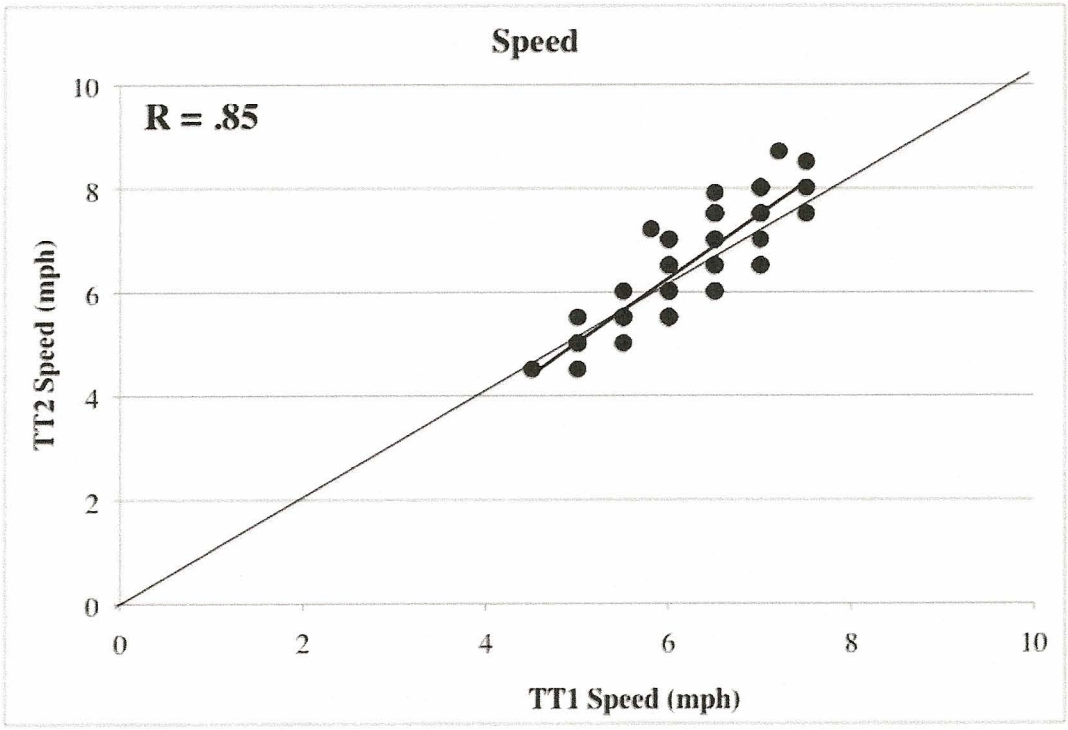
Figure 3. Talk Test responses during all training intensities.

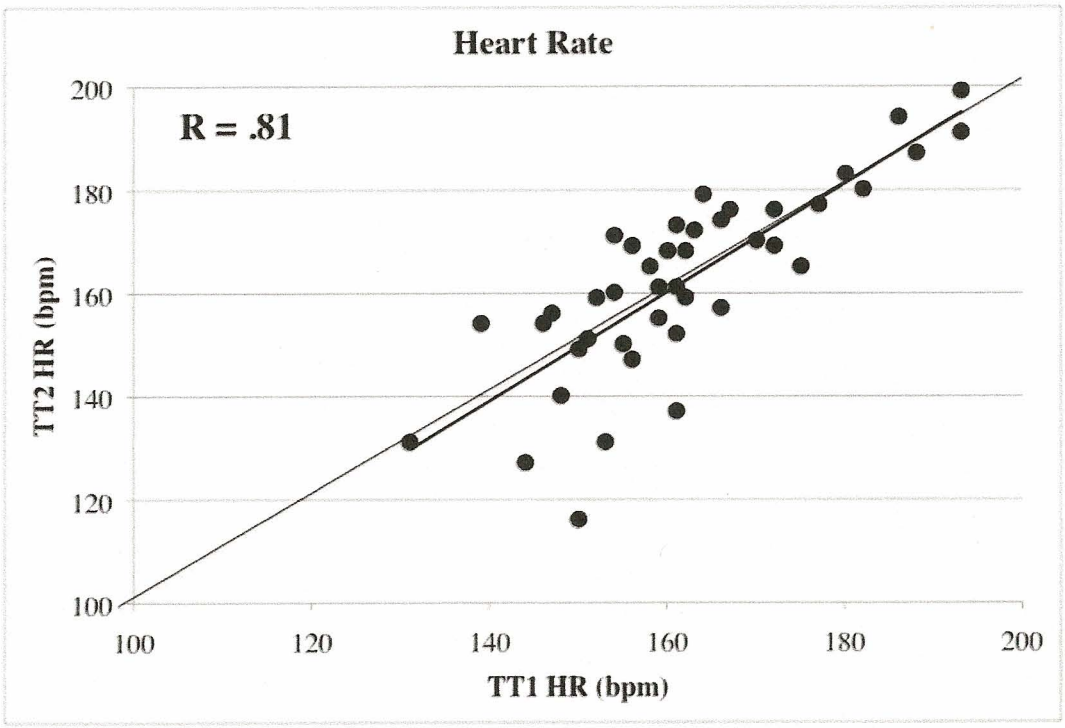
Reproducibility

The reproducibility of the exercise responses (speed, heart rate, and RPE) from each incremental exercise test is displayed in Table 2 and Figure 4. The speed at matched stages between the first and second incremental Talk Test were well correlated (R = .85) with one another suggesting that speed is reproducible from one test to the next. The heart rate and RPE values were moderately correlated (R =. 81 and .71 respectively) when the values were compared from the first and second incremental exercise tests. The slope of all exercise responses (speed, heart rate, and RPE) is consistent with the line of identity indicating that the responses during the Talk Test are basically reproducible. There were no significant differences between the speed, heart rate or RPE at any matched stage of the Talk Test.

Table 2. Means and standard deviations of all exercise responses (speed, heart rate, and RPE) during the first and second incremental exercise test.

	TT1 Mean ± SD	TT2 Mean ± SD
Max Speed TT	8.46 ± 1.15	8.53 ± 1.1
Speed LP-1	5.74 ± .64	6.05 ± 1.02
Speed LP	6.25 ± .64	6.56 ± 1.04
Speed EQ	6.76 ± .65	7.09 ± 1.08
HR LP-1	154 ± 14.02	153 ± 18.73
HR LP	163 ± 11.87	164 ± 16.6
HR EQ	170 ± 11.68	170 ± 15.75
RPE LP-1	2.82 ± .7	2.79 ± 1.12
RPE LP	3.46 ± .82	3.21 ± 1.17
RPE EQ	4.18 ± .8	4.07 ± 1.02


Speed
R = .85
TT2 Speed (mph)
TT1 Speed (mph)
0
2
4
6
8
10


Heart Rate
R = .81
TT2 HR (bpm)
TT1 HR (bpm)
100
120
140
160
180
200

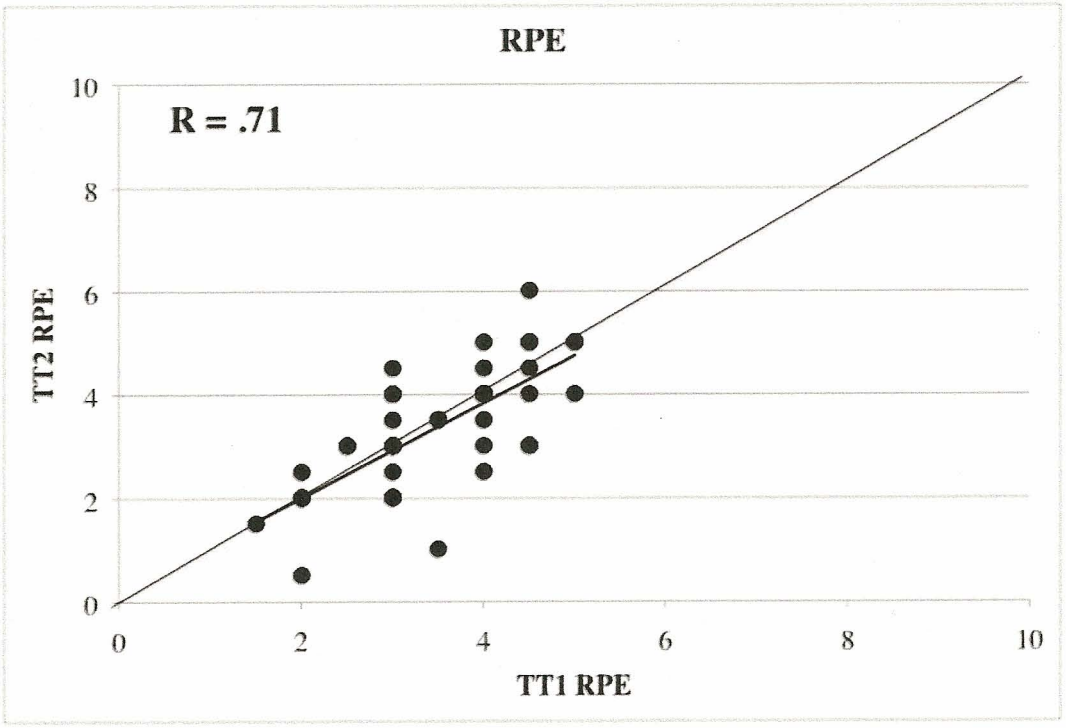
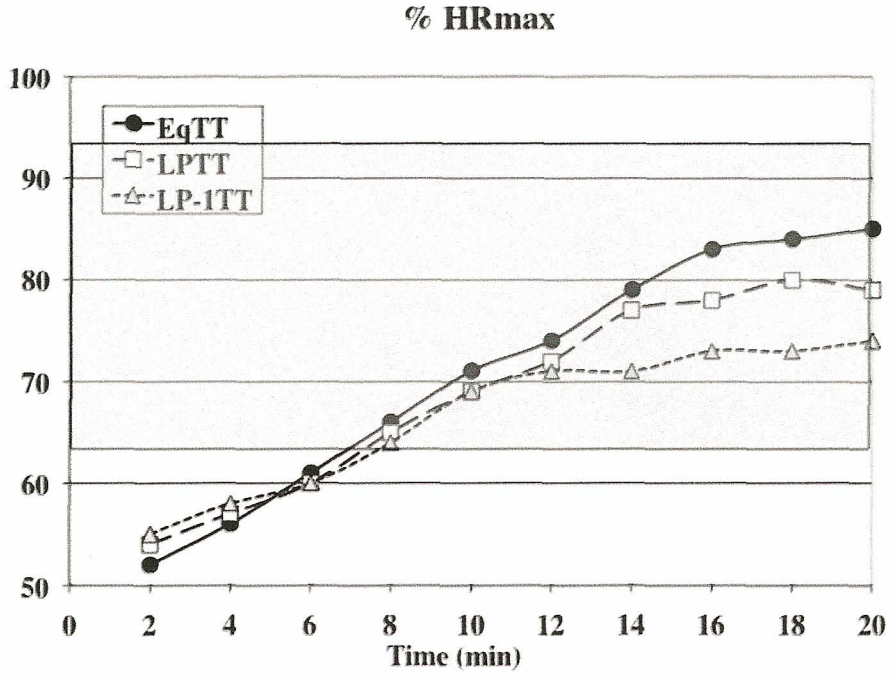


Figure 4. Relationship of speed, heart rate and RPE between the first and second incremental exercise tests to measure reproducibility.

DISCUSSION

All of the training bouts produced heart rate values within the recommended range according to the American College of Sports Medicine guidelines. The subjective responses, RPE and Talk Test, elicited the appropriate values during the LP-1 and LP training bouts. However, the EQ training bout generated subjective responses outside the recommended range. This suggests that that in order for someone to be able to speak comfortably during a 40-minute training bout, they would have to train at an intensity no harder than the stage from where their Last Positive Talk Test response occurred. This supports the hypothesis that the absolute intensity from an incremental exercise test must be less than that producing the ventilatory threshold.

These findings are consistent with a study, which found that the absolute intensity from an incremental exercise test must decrease by one stage from where the LP Talk Test stage in order for sedentary individuals to speak comfortably during a 20-minute bout (9). At the LP-1 intensity, the proper objective and subjective intensities were obtained. Our subjects were able to exercise within the recommended intensities when the speed at the Last Positive stage was used, which is consistent with greater exercise tolerance in trained individuals. In agreement with our current study, objective measures of exercise intensity (%METS and $\%HR_{max}$) were within the recommended range for all training intensities. This study found that the training bout based on the EQ stage produced subjective intensities outside the recommended range for RPE and TT responses, which is also consistent with the results of the present study. In Figure 5, exercise responses during each training bout from the earlier study are presented.



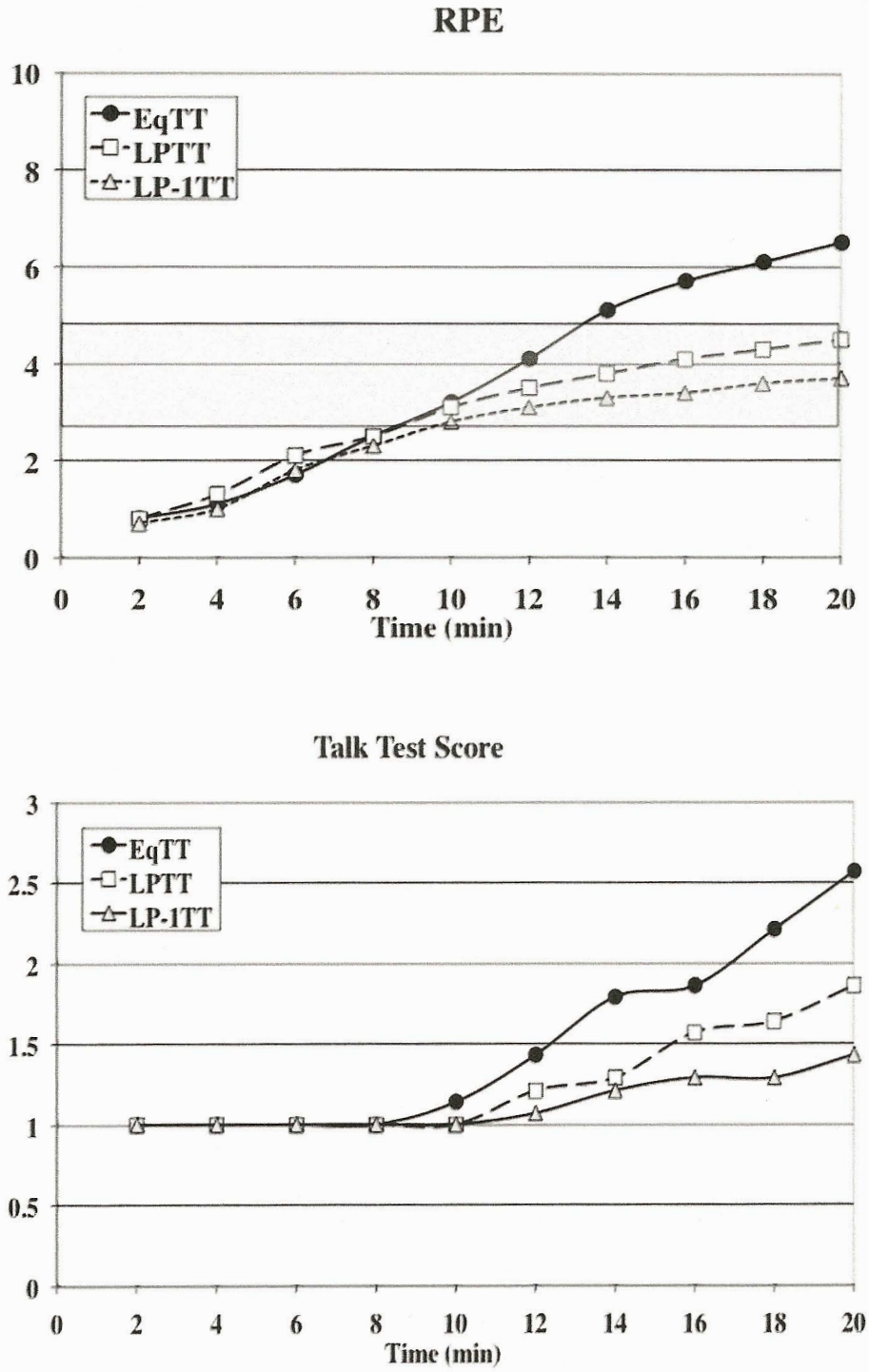


Figure 5. Heart rate, RPE, and TT responses during each 20-minute training bout.

An initial concern was that exercise responses such as speed, heart rate and Talk Test, would differ when multiple incremental exercise tests were performed. To make sure that the exercise responses were reproducible, two incremental exercise tests were performed. Each incremental exercise test produced exercise responses that were reproducible over subsequent tests, which eliminates this concern relative to using the Talk Test.

There are several ways the Talk Test could further be examined. First, the population studied was limited to physically active individuals who were moderately fit. It would be of interest to see the translation of the Talk Test in a cardiac population or elite level athletes. Another possibility to further examine the Talk Test would be to study the exercise responses and translation of the Talk Test with other modes of exercise such as cycling. Finally, a study examining the differences between pre and post Talk Test responses after training would further extend the knowledge of the Talk Test.

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APPENDIX A

INFORMED CONSENT

Proposal Title: Translation of the Talk Test to Exercise Prescription

Principal Investigator: Elizabeth Jeanes
220 N 14th Street
La Crosse, WI 54601
920-344-9605

Emergency Contact: Carl Foster
133 Mitchell Hall
608-785-8687

Purpose and Procedure

- The purpose of this study is to determine how much absolute intensity decreases from the intensity during an incremental exercise test during a 40-minute training bout to allow for comfortable speech in physically active individuals using the Talk Test.
- The first test required consists of an incremental test on either a treadmill or cycle ergometer in which the workload continues to increase until fatigue. I will wear a mouthpiece in which I breathe into and a heart rate monitor strapped around my chest during this test.
- The second test will consist of the same protocol as the first test except this time the Talk Test will be measured by reciting the 'Pledge of Allegiance'
- The subsequent three tests will be at varying intensities of the Talk Test established from the prior tests completed. They will be performed in random order lasting for 40 minutes. Throughout each test the Talk Test will be measured every 5 minutes by reciting the 'Pledge of Allegiance.'
- The total time required of me during this project is 4 hours over a 3 week time span.

Potential Risks

- Risks incurred from this study are minimal for physically active individuals and limited to muscle soreness and fatigue.
- If an emergency occurs, persons with CPR and Advanced Cardiac Life Support (ACLS) will be present during the study. An AED is located in the laboratory as well.
- The likeliness of serious complications during exercise is near zero for healthy individuals.

Rights and Confidentiality

- My participation in this study is voluntary and I may withdraw from the study at anytime and for any reason without penalty.
- The data will only be accessible to the principle investigator and faculty advisor.
- Information collected during the study will be coded with numbers and not labeled by personal information.

Possible Benefits

- My participation in this study will help validate that the Talk Test is a simple and practical way to measure exercise intensity for the general population.

Questions

If any questions arise from this study they may directed towards the principal investigator (Elizabeth Jeanes, 920-344-9605) or her faculty advisor (Carl Foster, 608-785-8687). Questions regarding the protection of human subjects may be addressed to the UWL Institutional Review Board for the Protection of Human Subjects (608-785-8124).

Subject Name (Please Print)	Signature	Date
Researcher Name (Please Print)	Signature	Date

APPENDIX B

RATING OF PERCEIVED EXERTION

Borg's Rating of Perceived Exertion Scale (3)

0	No Effort
0.5	Standing at rest
1	Very Light
2	Light
3	Moderate
4	Somewhat Hard
5	Hard
6	
7	Very Very Hard
8	
9	
10	Maximal Effort

APPENDIX C

PLEDGE OF ALLEGIANCE

"Pledge of Allegiance"

"I pledge allegiance to the flag of the United States of America and to the Republic for which it stands, one Nation under God, indivisible with liberty and justice for all."

APPENDIX D

REVIEW OF LITERATURE

Introduction

Of the four variables of the FITT principle (frequency, intensity, time, and type) that are commonly used to prescribe exercise, intensity is widely known as the most difficult variable to define. Normally, intensity is prescribed as 60-94% of HR_{max} or 50-85% of maximal METS (1,17). However, these current definitions present several obstacles. First, individuals must complete a maximal effort test in order to know their HR_{max} or maximal METS. These tests require trained professionals and equipment. In addition, a physician must be present for a maximal test in males over 45 and females over 55 years old. A maximal effort test has also been shown to be ineffective if handrail support is permitted (2). A second obstacle is that there is a wide range of relative percent values, a concept addressed by Katch et. al. (13). Beginning exercisers may choose a percentage that is too high therefore increasing their risk of complications during exercise (10). Finally, the current definitions fail to define the absolute intensity (e.g. speed and grade of walking) at which an individual should work. However there are "translation" techniques, which can be used as an alternative way to prescribe intensity (8).

Talk Test

An alternative method for prescribing exercise intensity is the Talk Test (TT). The TT is defined as working at the highest intensity, which allows an individual to speak comfortably. To measure the TT an individual is asked "Can you speak comfortably?" to

which they may respond 'yes', 'not sure' or 'no'. 'Yes' is defined as a positive TT, 'not sure' is defined as equivocal and 'no' is defined as the first negative TT.

The first study completed related to the TT was one that asked patients to distinguish when they could "hear their breathing" (12). Goode et. al. hypothesized that this would produce an exercise intensity within the recommended range 60-90% of HR_{max}. To test their hypothesis, 19 male subjects completed an initial VO_{2max} test followed by an exercise bout on a cycle ergometer and track. Goode et. al. found that when the subjects could "hear their breathing" they were working at an intensity near their VT. At this intensity, they were also within the recommended range according to the American College of Sports Medicine (ACSM) guidelines (60-90% of HR_{max}).

Brawner et. al. examined the Talk Test in sedentary individuals by having them complete two incremental exercise tests while measuring their heart rate and VO_{2max} (3). Czaplicki et. al. completed a similar study which measured the TT on a treadmill and dual action cycle ergometer (6). In both studies (3,6), the TT resulted in intensities, which fell within the ACSM guidelines of 60-90% of VO_{2max}. Therefore it was concluded that the TT could be used to measure exercise intensity in sedentary adults.

There have been several studies done which have found that the TT estimates VT in a variety of populations (7, 19, 21, 22). The first population in which the Talk Test was found to be a surrogate of VT was healthy, university students (7). Twenty-eight males and females who exercised regularly were subjects in this study. Each subject completed two maximal exercise tests, one to determine their VT and the other to evaluate the TT. The results of the study found that when the subjects could speak

comfortably, they were working at an intensity below or at their VT. Additionally, when the subjects could not speak comfortably, they were at an intensity above their VT. All stages of the Talk Test produced exercise responses such as heart rate and VO_{2max} within the ACSM guidelines for exercise intensity.

Sedentary individuals (21), well trained athletes (19) and cardiovascular patients (22) were the next populations tested to evaluate the relationship between the TT and VT. Schafer et. al. performed a similar procedure as the previous study (7), however she assessed the TT by using a shorter paragraph, 'The Pledge of Allegiance.' The study found that the TT was a valid way to measure exercise intensity in sedentary individuals, which resulted in exercise intensities within the ACSM guidelines.

Recalde et. al. (19) and Voelker et. al. (22) assessed the TT in well trained athletes and patients with cardiovascular disease respectively. Two maximal exercise tests were performed, one measuring gas exchange and the other the Talk Test. In all populations (7, 19, 22), similar results were found. When subjects could speak comfortably they were working at an intensity below their VT. The objective measures (e.g. $\%VO_{2max}$ and $\%\ HR_{max}$) also fell within the ACSM guidelines for exercise intensity.

Brawner et. al. examined the Talk Test as a surrogate of VT in patients with coronary artery disease (4). The TT was evaluated during an incremental exercise test as well as a training bout on a track. To evaluate the Talk Test on the track the subjects wore headphones and spoke when they were directed. The results determined that subjects were not able to speak at a level above their VT and that exercise responses such as HR and RPE fell within the recommended ACSM guidelines for intensity.

Meyer et. al. evaluated the relationship between the onset of ischemia and the VT (14). Twenty-seven males who had downsloping or horizontal ST depression and a history of coronary artery disease were participants in the study. Each subject performed an incremental exercise test on a cycle ergometer. An electrocardiogram monitored the onset of ischemia and VT was determined by gas exchange analysis. The results of the study found that VT occurred before the ischemic threshold in a majority of the patients.

With the results of the previous study (14), Cannon et. al. decided to look at whether the Talk Test was a surrogate of VT in patients with exertional ischemia (5). A total of 19 subjects with horizontal or downsloping ST segments participated in the study. The study found that in a majority of the subjects, the intensity at which they could speak comfortably occurred before their ischemic threshold. Therefore, Cannon et. al. concluded that the Talk Test is a safe and useful method to avoid myocardial ischemia in individuals with exertional ischemia.

Persinger et. al. examined the consistency of the TT (16). To determine consistency, the TT was evaluated in different modalities. Sixteen healthy individuals who were moderate exercisers performed incremental exercise tests on a treadmill and cycle ergometer. The study found that the TT was consistent in both modalities. In each modality, when the subjects could speak comfortably they were below or at their VT. The TT also produced exercise responses that fell within the ACSM guidelines for intensity as well.

Foster et. al. examined if the Talk Test would respond accordingly to changes in VT when VT was manipulated (9). Four independent series of studies were performed.

In the first, two incremental exercise tests were performed, one before and one after blood donation. In the second, two incremental exercise tests were performed again, but this time one occurred before and after a six-week training program. One incremental exercise test measured the Talk Test and the other determined the VT by gas exchange analysis in both studies. The third study manipulated the VT by changing the intensity (power output) on the cycle ergometer during a 30-minute training bout. Lastly, VT was manipulated in the fourth study by starting at the intensity of their VT and increasing intensity until speech became uncomfortable. The results of each study found that when VT was manipulated via blood donation, training or changes in intensity during a training bout, the Talk Test was able to track changes in VT. Foster et. al. established that TT was an accurate way to evaluate exercise intensity as well as a useful tool when prescribing exercise.

Another study evaluated the Talk Test as a simple tool to prescribe exercise intensity in a cardiac rehabilitation setting (18). The TT was evaluated during a pre and post-submaximal exercise test. From the pretest results, a program was created for the individual based on their heart rate, RPE, and TT responses. At the end of the training program, Recalde et. al. found that the subjects functional capacity increased. They concluded that the Talk Test could be used to individualize a cardiac rehabilitation program specific to the patients' needs.

The current definitions of exercise intensity fail to establish absolute intensity. Therefore, Foster et. al. examined whether the exercise responses (e.g. heart rate) from a graded exercise test could be used to determine the absolute intensity (e.g. pace of walking) during exercise training (8). At that time, target heart rate was commonly used

to prescribe exercise intensity, however absolute intensity was not prescribed. To test their hypothesis, they had subjects who participated in cardiac rehabilitation and preventative programs complete a graded exercise test followed by an exercise-training bout. The study found that absolute exercise intensity from the graded exercise test could be 'translated' and used to achieve a given heart rate during exercise training (8).

The limitation of the previous study (8) was that it required maximal exercise testing, which were not readily available for much of the population. Therefore, Foster et. al. determined how much of a reduction in absolute intensity from an incremental exercise test was required to allow for comfortable speech during a 20-minute bout in a sedentary population (11). Many beginning exercisers are not only interested in objective markers (e.g. heart rate) of exercise intensity, but the absolute dimensions (e.g. speed and grade of walking) as well. The study included 14 healthy, but sedentary individuals who completed an incremental exercise test until fatigue. From this test, the intensities of the three subsequent 20-minute bouts were determined.

The results of the study found that all three intensities produced heart rate and RPE values which fell within the ACSM guidelines for intensity. It also determined that a 10 percent decrease in absolute intensity from the incremental exercise test was necessary to allow for comfortable speech during the 20-minute bout (11). It was concluded that the TT would lead to compliance in sedentary individuals since they are likely to discontinue their exercise program if they start at an intensity too high. Furthermore, the use of the TT to define exercise intensity would minimize the risk of complications during exercise for this population (10).

There have been variations of the TT which have been tested. The first variation measured exercise intensity with a Ratings of Perceived Speech Production Difficulty (PSPD) (20). The PSPD is a 13 level scale, which rates the difficulty of speech production. Fourteen healthy individuals completed an incremental test in which their PSPD was measured as well as other objective measures (e.g. heart rate). The study found that the PSPD tended to under or over estimate exercise intensity and was not valid.

The second variation of the TT is the Counting Talk Test (CTT) (15). This study compared the CTT to the Heart Rate Reserve method for measuring exercise intensity. The test required an individual to take a full breath in and count out loud until another breath was necessary. It was concluded that the CTT produced exercise responses within the ACSM guidelines.

Summary

In conclusion, there are many discrepancies with the current definitions (%HR_{max} or %maxMETS) of exercise intensity. The Talk Test has been shown to be a valid way to evaluate and prescribe exercise intensity in a variety of populations. It also produces exercise intensities within the recommended range according to ACSM guidelines. It would be advantageous to further study the absolute dimensions (e.g. pace of walking) of the TT. This information would most likely lead to better compliance and lower risk of complications during exercise.

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