

UNIVERSITY OF WISCONSIN-LA CROSSE

Graduate Studies

THE TALK TEST AS A MEASUREMENT OF EXERCISE INTENSITY IN  
CHILDREN: REPLICATION STUDY

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

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CHILDREN: REPLICATION STUDY

By: Makayla Jade Heim

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

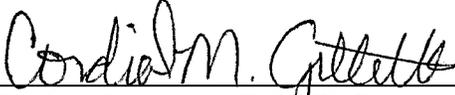
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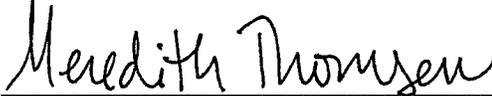
  
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## ABSTRACT

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The aim of this study was to identify the replicability of the Talk Test as an indicator of exercise intensity in children. This study specifically looked at whether the TT could be used as a measurement of exercise intensity in children from age nine to 12. Ten children were recruited to perform the study. Subjects completed two visits at the laboratory. The first visit was to familiarize the child with equipment and complete an exercise test using the TT. The second was completing a maximal exercise test performed on a motorized treadmill while measuring respiratory gas exchange. The gas exchange test was used to measure each subject's ventilatory threshold (VT). Results from the last positive (LP), equivocal (EQ), and negative (NEG) stage of the TT were compared to VT. There were no differences between  $\text{VO}_2$  at VT during any of the TT stages. HR at VT was significantly different compared at the NEG stage of the TT ( $p < .05$ ). RPE was significantly different than RPE at VT compared at NEG and LP stage of the TT ( $p < .05$ ). There were no significant differences when comparing the previous data to the current data. Specifically, there was no significant difference between  $\text{VO}_2$  and TT stages when comparing the Giddings (2018) data and the current data. We concluded that children that are exercising to a point where it is uncomfortable to speak are exercising below their VT. We are confident that the replicability of the TT is an adequate tool to support the TT as a valid measure of exercise intensity in children.

## ACKNOWLEDGEMENTS

I am truly grateful for the opportunity to have worked with people who have continuously supported me and helped me achieve my goals. Dr. Carl Foster has been a tremendous help with his guidance and advice. I have truly enjoyed working with you and having plenty of laughs in the process.

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## TABLE OF CONTENTS

	Page
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
LIST OF APPENDICES.....	viii
INTRODUCTION.....	1
METHODS.....	3
Subjects.....	3
Protocol.....	4
Talk Test.....	5
Maximal Test.....	5
Statistical Analysis.....	5
RESULTS.....	7
DISCUSSION.....	12
CONCLUSION.....	14
REFERENCES.....	15
APPENDICES.....	17

## LIST OF TABLES

	Page
1. Descriptive Characteristics of the Children.....	3
2. Giddings, 2018 Descriptive Characteristics of the Children.....	4
3. Outcome Variables at VT and Last Positive, Equivocal, and Negative Stages of the Talk Test.....	8

## LIST OF FIGURES

FIGURE	Page
1. Oxygen Consumption Compared between VT and Last Positive, Equivocal, and Negative Stages of the Talk Test.....	8
2. Heart Rate Compared between VT and between VT and Last Positive, Equivocal, and Negative Stages of the Talk Test.....	9
3. RPE Compared between VT and between VT and Last Positive, Equivocal, and Negative Stages of the Talk Test.....	9
4. Gas Exchange versus Talk Test Oxygen Consumption during the Talk Test.....	10
a. Gas Exchange versus TT Oxygen Consumption during LP stage.....	10
b. Gas Exchange versus TT Oxygen Consumption during EQ stage.....	11
c. Gas Exchange versus TT Oxygen Consumption during NEG stage.....	11

## LIST OF APPENDICES

APPENDIX	Pages
A. Informed Consent.....	17
B. RPE Scale.....	21
C. Reading Passages.....	23
D. Review of Literature.....	28

## INTRODUCTION

From the perspective of contributing to scientific research, replication studies are critical elements for the progress of science (Halperin et al., 2018). In order for research to be significant and meaningful, it also needs to be replicable. Replicability of research allows for validation of results and inspection of reliability which may increase the confidence in previous results. However, research journals are less eager to publish replication studies due to the fact that they are not novel findings, and therefore are potentially less interesting to their readers. However, in a period of highly competitive research, the need for validation studies remains critical.

The aim of this study was to identify the replicability of the Talk Test (TT) as an indicator of exercise intensity in children. According to the Centers for Disease Control and Prevention (CDC), the prevalence of childhood obesity has become a severe problem in the United States. In 2016, the CDC reported that the prevalence of obesity among U.S. youth was 18.5%. Obesity is being described as an epidemic in the U.S. The CDC recommends maintaining a healthy diet and participating in physical activity (PA) (Centers for Disease Control and Prevention 2015). Both the CDC and American College of Sports Medicine (ACSM) recommend 60 or more minutes of vigorous-intensity aerobic activity, for at least three days per week for both children and adolescents (Riebe, 2017).

Physiologic exercise response tests are completed to determine the intensity of exercise and exercise capacity of the participant. These tests of physiological response

and exercise intensity are easy to perform in a laboratory setting because of the readily available equipment. In a non-laboratory setting, it is more difficult to identify intensity of exercise due to the lack of being attached to monitoring equipment. Therefore, subjective measures for exercise intensity have become popular to simplify exercise evaluation. Subjective tests allow for simple questions (i.e. “How hard was your workout?” (Foster et al. 1995), (“Are you able to speak comfortably?”) (Foster et al. 2018)) to be asked about intensity and to predict the relative intensity experienced. Previous studies have established the Talk Test (TT) as a valid measure of exercise intensity (Foster et. al., 2018), that it is reliable with adults (Ballweg et. al., 2013), and that marks intensity well in children (Giddings, 2018). This study was designed to determine whether the TT is a replicable measure of exercise intensity in children age nine to 12.

## METHODS

### Subjects

This study was approved by the Institutional Review Board of the University of Wisconsin-La Crosse. All subjects were given an informed consent for parents to sign, as well as an assent document to be signed by the child. The subjects` also filled out a Physical Activity Readiness Questionnaire (PAR-Q) and an Exercise History Questionnaire in order to determine any limitations or contraindications that would disqualify their participation. Ten children were recruited to perform the study. Five girls and five boys participated, ranging in age from nine to 12. Analysis was performed on N=10 (5 boys, 5 girls) children that completed the TT and VO<sub>2</sub> max test. Descriptive characteristics of the subjects are summarized in Table 1. The data were compared to a previously studied group drawn from the same population (Giddings, 2018). The characteristics of this group are presented in Table 2.

Table 1. Descriptive characteristics of the children (N=10).

Variable	Girls (n=5)	Boys (n=5)	Total (N=10)
Age (years)	9.6±0.55	10.6±0.89	10.1±0.88
Height (cm)	136.6±4.17	150.6±10.31	143.6±10.44
Weight (kg)	32.4±3.92	43.8±8.02	38.1±8.44
VO <sub>2</sub> max (L*min <sup>-1</sup> )	1.3±0.23	1.9±0.39	1.6±0.43
VO <sub>2</sub> max (mL*kg <sup>-1</sup> *min <sup>-1</sup> )	41.3±7.20	43.5±1.53	42.4±5.05
VO <sub>2</sub> at VT (L* min <sup>-1</sup> )	0.84±0.259	1.3±0.10	1.1±0.29
HRmax (b*min <sup>-1</sup> )	192.6±11.93	180.2±8.23	186.4±11.66
HR at VT (b*min <sup>-1</sup> )	127.8±29.81	146.4±6.03	137.1±22.52
RERmax	1.0±0.45	1.0±0.37	1.0±0.04

Values represented by mean ± standard deviation.

Table 2. Giddings, 2018 Descriptive characteristic of the children (N=13).

Variable	Girls (n=6)	Boys (n=7)	Total (N=13)
Age (years)	9.7±1.51	9.4±1.27	9.5±1.33
Height (cm)	142.2±12.05	140.8±7.97	141.4±9.63
Weight (kg)	34.8±10.41	40.4±13.55	37.8±12.06
VO <sub>2</sub> max (L*min <sup>-1</sup> )	1.31±0.528	1.85±0.735	1.60±0.683
VO <sub>2</sub> max (mL*kg <sup>-1</sup> *min <sup>-1</sup> )	36.3±9.59	45.9±11.61	41.5±11.42
VO <sub>2</sub> at VT (L* min <sup>-1</sup> )	0.61±0.242	1.24±0.636	0.95±0.580
HRmax (b*min <sup>-1</sup> )	169±15.3	183±12.7	177±15.0
HR at VT (b*min <sup>-1</sup> )	122±9.6	147±16.4	136±19.0
RERmax	0.98±0.06	0.99±0.06	0.98±0.06

Values represented by mean ± standard deviation.

### Protocol

The subjects came into the laboratory on two separate days. The first day included familiarizing the subject with the treadmill, as well as completing a maximal exercise test using the TT. The second visit was accomplished at least 48 hours after the first visit. The subjects completed a maximal exercise test on the treadmill while measuring respiratory gas exchange. Heart rate (HR) was assessed during both visits using radiotelemetry (Polar Vantage XL, Polar USA, Lake Success, New York). A Rate of Perceived Exertion (RPE) scale (Nye & Todd, 2013), designed specifically for children, was used as an assessment of exertion during exercise tests. The exercise protocol used was a modified Balke protocol. Warm up and cool down stage was completed at one and a half miles per hour (mph) at a zero percent grade. Speed was kept constant at three mph for all tests. Percent grade began at zero then gradually increased by two percent at each stage. HR and RPE were recorded in the final seconds of each stage.

### **Talk Test**

The Talk Test was measured during the last minute of each two minute stage by reading a short passage. Each passage was selected by the child based on appropriate reading level, and was of around 100 words in length (Schroeder, Foster, Porcari, and Mikat, 2017), and was read aloud. The researcher asked “Can you speak comfortably?” after every reading. A positive response (pos) was marked at each stage when the child answered that they could speak comfortably (i.e. “Yes”). An equivocal response (EQ) was marked at the stage when speech was comfortable/difficult (i.e. “Yes, but...”). A negative response (NEG) was marked at the time the child indicated that speech was definitively not comfortable. During the last 10 seconds of each stage, RPE and HR were recorded.

### **Maximal Exercise Test**

Maximal oxygen uptake ( $\text{VO}_2$ ) and ventilatory threshold (VT) were measured during the maximal exercise test. A maximal RPE was used to determine when to stop the maximal exercise test. Open-circuit spirometry (Moxus Metabolic Cart System, AEI Technologies, Pittsburgh, Pennsylvania) was used to measure respiratory gas exchange. The metabolic cart was calibrated using a 3.0 L syringe and known gas concentrations. The “V”-slope method and Ventilatory Equivalent Method (Beaver, Wasserman, & Whipp, 1986) were used to identify the VT. The maximal exercise test was used to identify VT for each subject. TT results were compared to the outcomes of the maximal exercise test at each TT stage.

### **Statistical Analysis**

Data were analyzed by using a one-way analysis of variance (ANOVA). Relationships of the variables were used to compare the association between HR,  $\text{VO}_2$ ,

and RPE at VT versus the LP, EQ, and NEG stages of the TT. When there was a significant F ratio, Tukey's post-hoc tests were used to compare the VO<sub>2</sub>, HR, and RPE at VT versus stages of the TT. A p-value of <.05 was considered as statistically significant. Additional analysis was performed by using a two-way ANOVA with repeated measures to compare the data with the results of Giddings (2018). Additionally, scatter plots comparing the relationship between VO<sub>2</sub> at the LP, EQ, and NEG stages of the TT were constructed for both the current data and for the Giddings, 2018 data.

## RESULTS

Data in Table 3 compares HR, VO<sub>2</sub>, and RPE measures that were collected at VT, LP, EQ, NEG stages of the TT and maximal exercise. From results of the one-way ANOVA, there were no significant differences between VO<sub>2</sub> at any of the TT stages and VO<sub>2</sub> at VT. There was a significant difference between the NEG stage VO<sub>2</sub> compared to VO<sub>2</sub> of the EQ and LP stages of the TT. For RPE, there was a significant difference between RPE at VT versus RPE at the LP stage of the TT. There was no significant difference between RPE at VT and RPE at EQ and NEG TT stages. A significant difference was evident between RPE at NEG TT stage when compared to VT, LP, and EQ TT stages. Lastly, HR at VT was not significantly different than HR at any stage of the TT. There was a significant difference between HR at the NEG TT stage when compared to HR at VT, LP, and EQ TT stages.

The pattern of results of this study are similar compared to the results of Giddings (2018). Both of the studies had a significant difference when comparing HR at VT and HR at NEG TT stage. Additionally, both studies had similar findings of a significant difference when comparing RPE at VT and RPE at the NEG and LP stage of the TT.

The two-way ANOVA test was used to clarify if there were any significant differences between the two sets of data when compared to TT stages. There was no significant difference between VO<sub>2</sub> and TT stages when comparing results. This outcome suggests that VO<sub>2</sub> data from Giddings (2018) and the current data are not statistically different ( $p=.667$ ). Findings for HR ( $p=.325$ ) and RPE ( $p=.854$ ) were, likewise, found to

be not significantly different than Giddings (2018). Figures 1-3 show the relationships of these stages along with comparisons of values from Giddings (2018). Bar measurements are the mean values, with error bars representing standard deviation.

Table 3. Outcome variables at VT, LP, EQ, and NEG stages during the TT.

Variable	VT	LP	EQ	NEG	Max
VO <sub>2</sub> (L*min <sup>-1</sup> )	1.05±0.292	0.81±0.282	0.93±0.276	1.28±0.298	1.6±0.43
HR (b*min <sup>-1</sup> )	137.1±22.52	128.6±21.06	133.6±23.82	166.9±24.69*	186.4±11.66
RPE	5.2±2.02	3.4±1.18*	4.3±1.21	7.7±1.33*	9.1±1.21
Giddings (2018)					
VO <sub>2</sub> (L*min <sup>-1</sup> )	0.95±0.580	0.71±0.284*	1.04±0.427	1.17±0.504	1.60±0.683
HR (b*min <sup>-1</sup> )	136.0±19.0	126.3±12.91	152.5±15.40*	160.5±16.28*	177±15.0
RPE	5.2±2.70	3.6±1.32*	6.2±1.30	7.2±1.09*	9.7±0.3

Values represented by mean ± standard deviation.

\* Statistical difference compared to VT (p<.05).

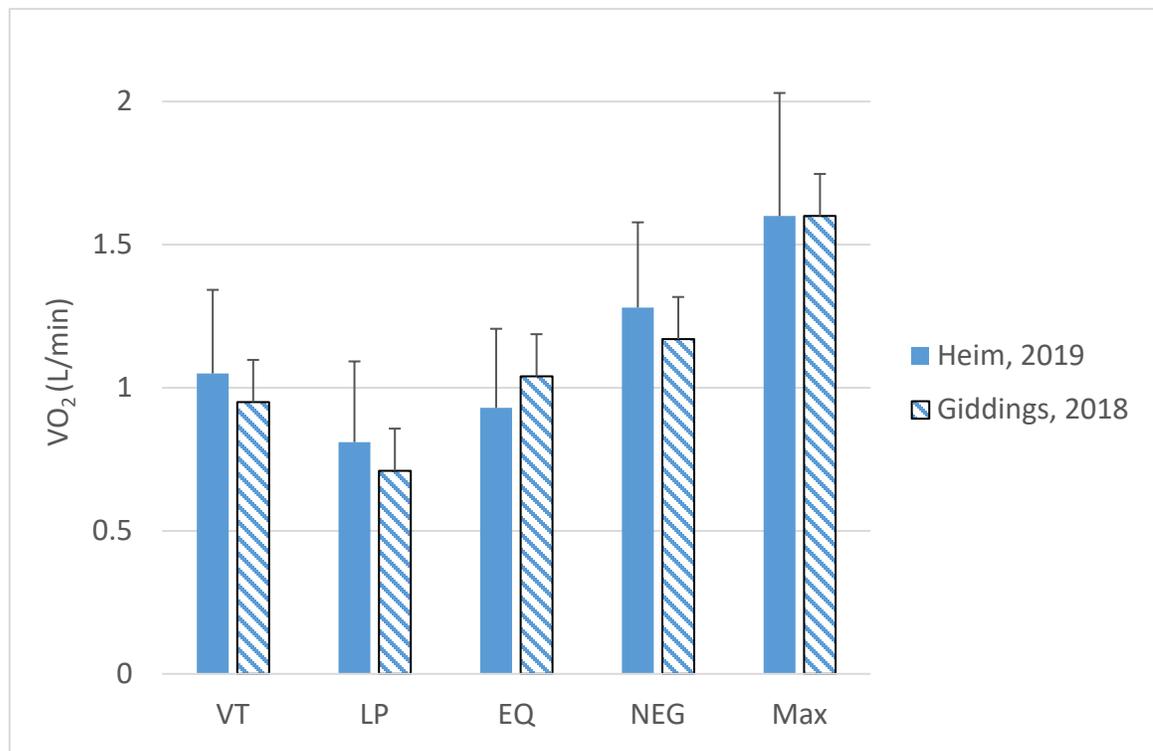


Figure 1. Oxygen consumption compared between VT, LP, EQ, NEG, and Max stages of the TT.

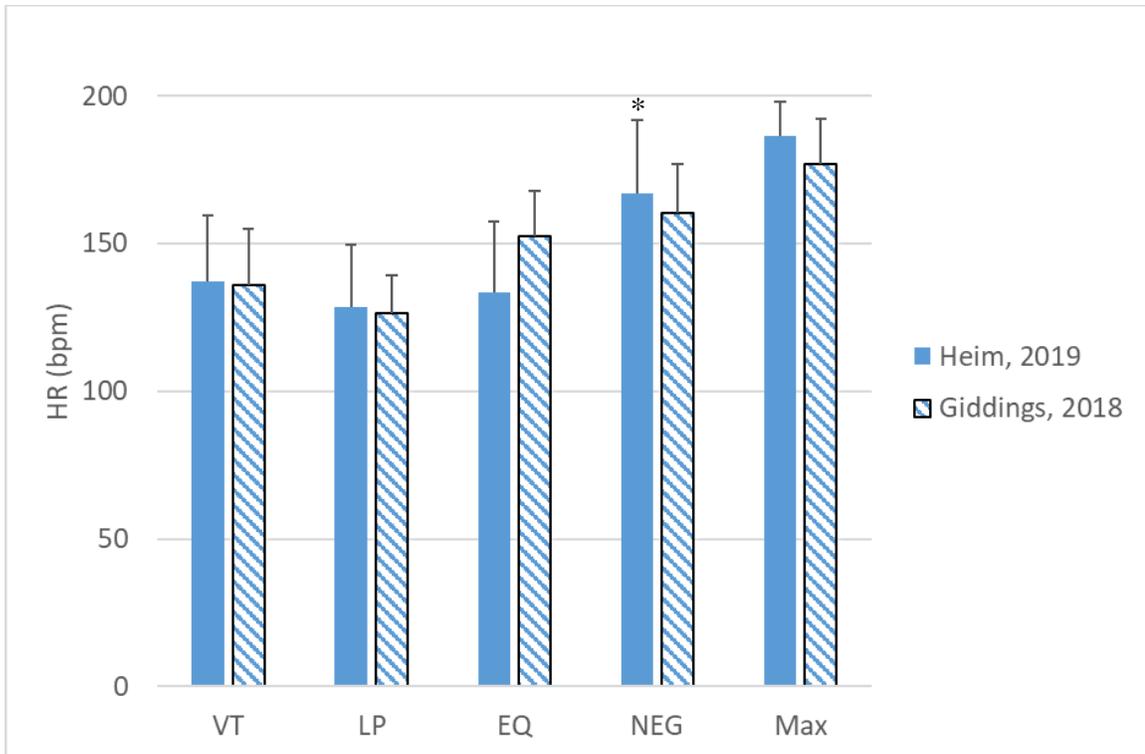


Figure 2. Heart Rate compared between VT, LP, EQ, NEG and Max stages of the TT.

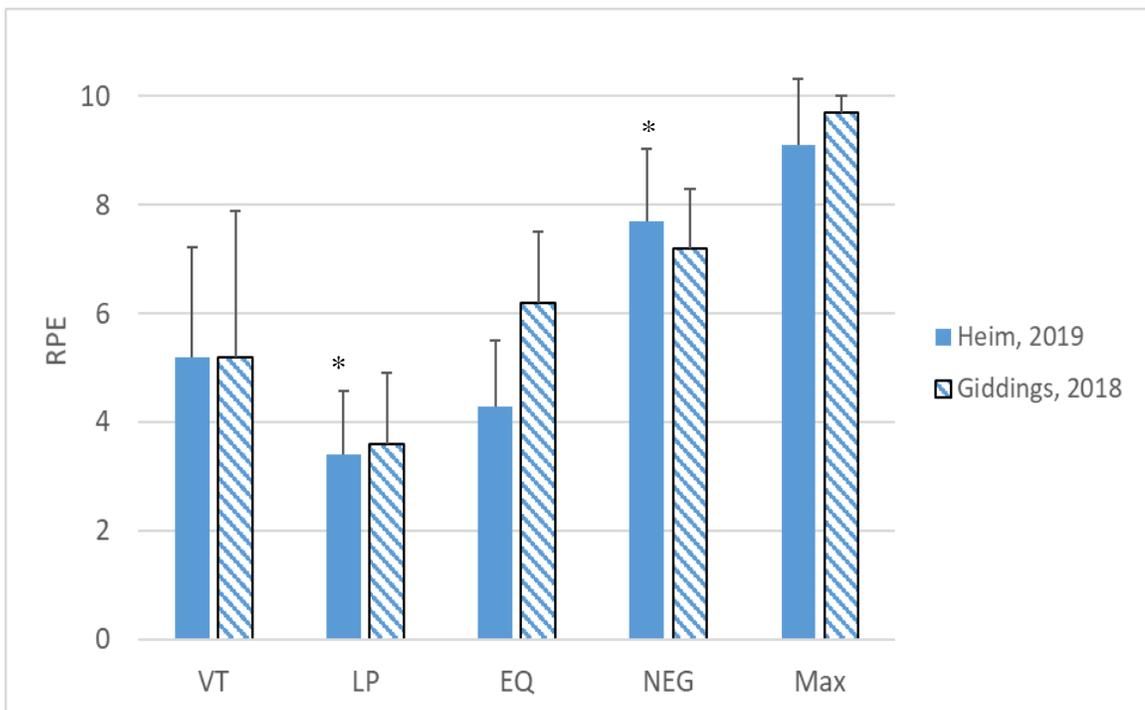


Figure 3. RPE compared between VT, LP, EQ, NEG, and Max stages of the TT

Figure 4 shows the relationship between  $VO_2$  at VT and  $VO_2$  at the LP, EQ, and NEG stages of the TT. Correlations were made by including data from Giddings (2018). Results of  $VO_2$  at the LP stage of the TT and  $VO_2$  at VT were nearly similar with a correlation of  $r=0.79$ , and Giddings (2018) found a correlation of  $r=0.62$ . For  $VO_2$  at the EQ stage of the TT and  $VO_2$  at VT the correlation ( $r=0.75$ ) was the same as Giddings (2018) ( $r=0.75$ ).  $VO_2$  at NEG stage ( $r=0.76$ ) of the TT was also similar to the results in Giddings (2018) ( $r=0.68$ ).

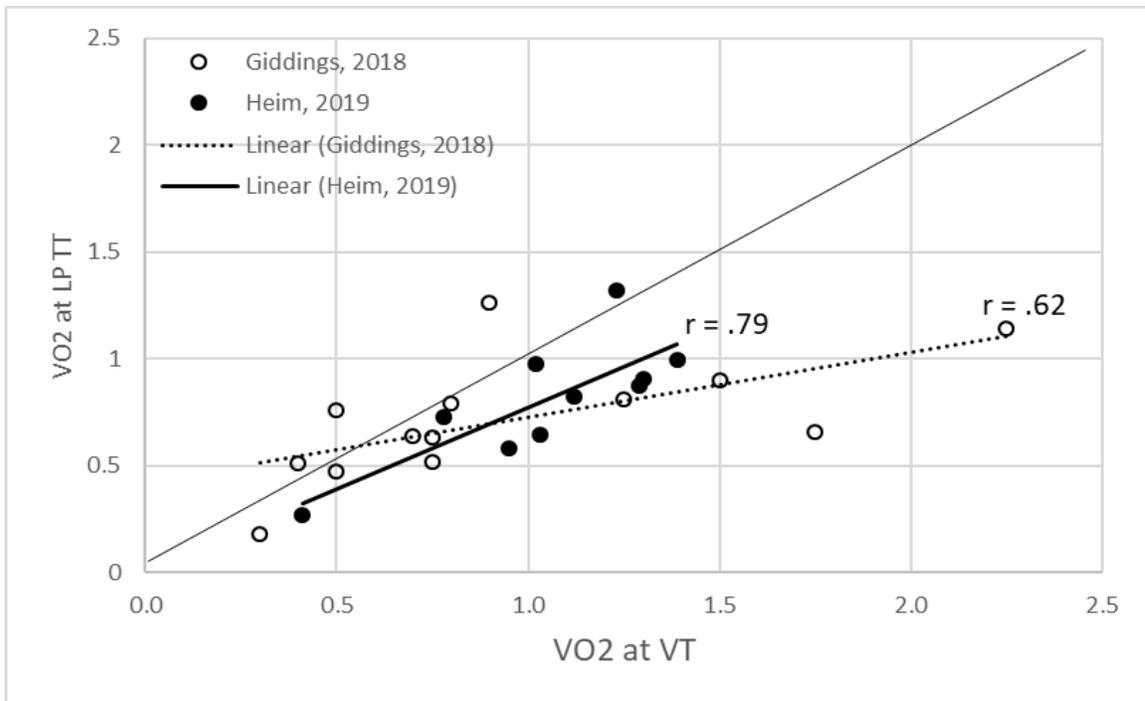


Figure 4a. Gas Exchange versus TT oxygen consumption at LP stage.

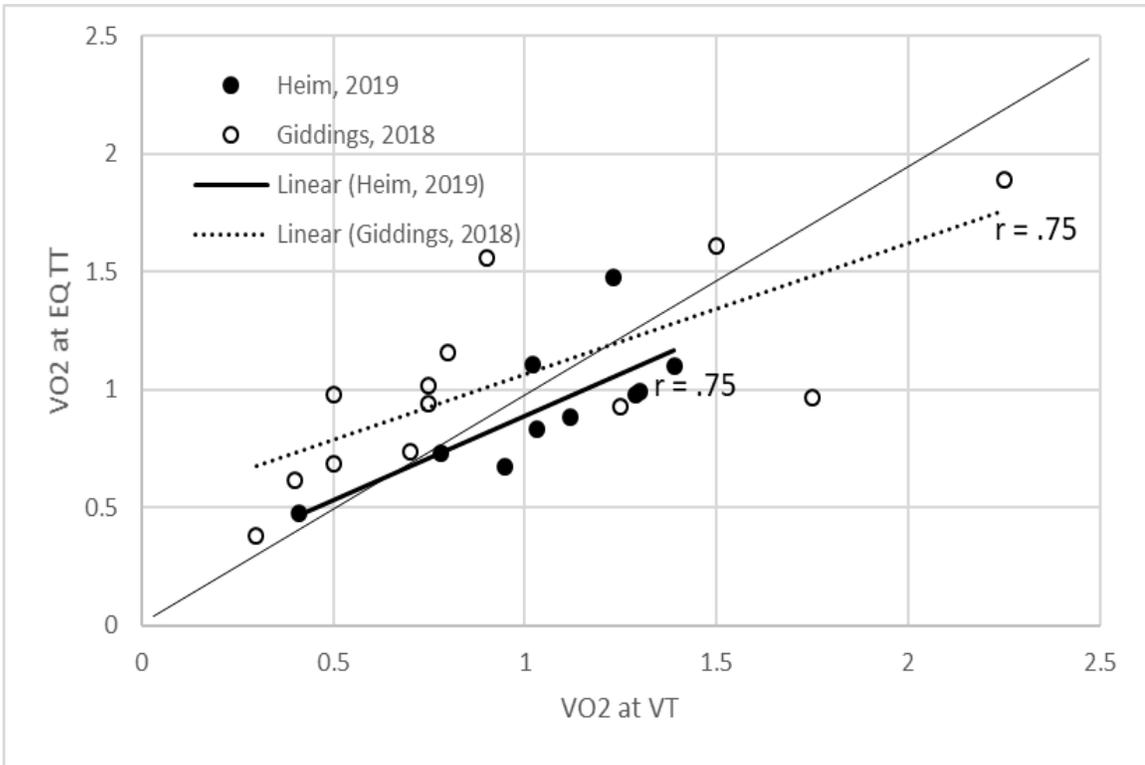


Figure 4b. Gas Exchange versus TT oxygen consumption at EQ stage.

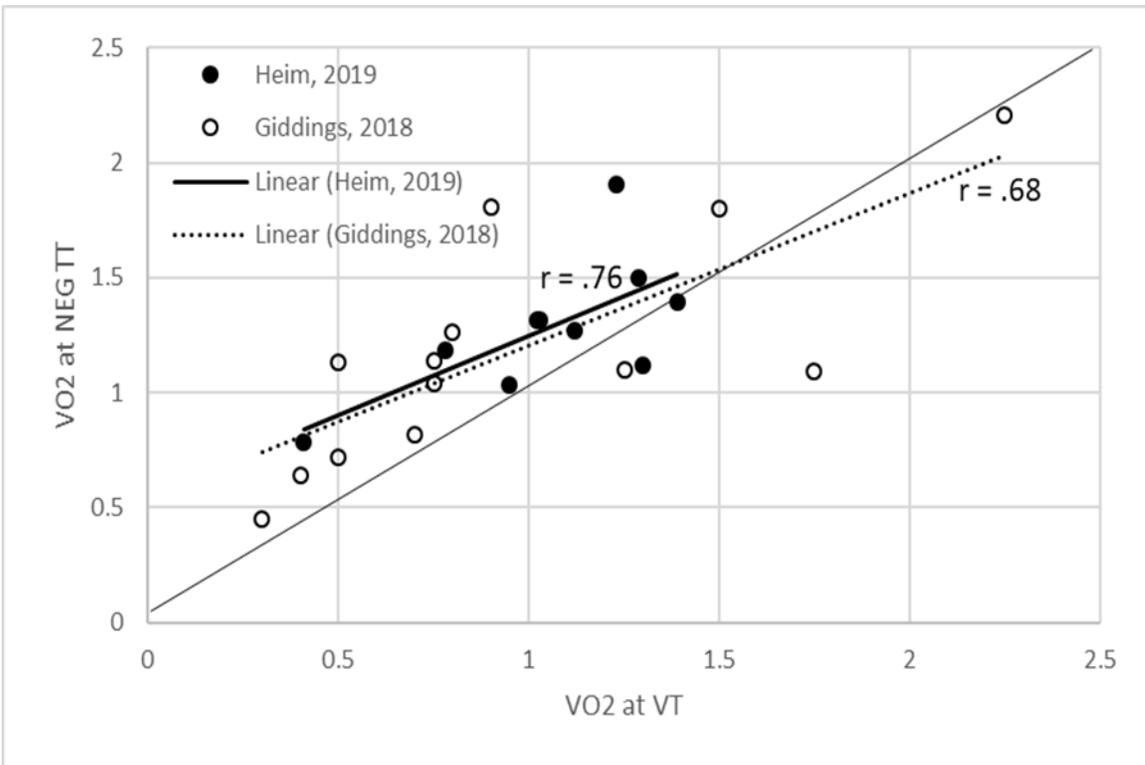


Figure 4c. Gas Exchange versus TT oxygen consumption at NEG stage.

## DISCUSSION

The purpose of this study was to determine whether the TT is a replicable measure of exercise intensity in children age nine to 12. This was achieved by comparing  $VO_2$  at VT to  $VO_2$  at each TT stage with the results of a similar previous study. The main result of this study suggests that the TT is a replicable measure of exercise intensity due to the comparisons with Giddings (2018) in that the pattern of the relationship between TT stages and VT is the same (e.g. the EQ stage approximates the response at the VT, the LP stage is generally less than VT and the NEG stage is generally greater than VT). The current data and the Giddings (2018) data suggest that when the subjects answered equivocally (EQ) they were at an intensity comparable to their VT. Previous data and the current data concur that the subject's response before (LP) and after (NEG) during the TT are comparable to occurring below and above their VT respectively. These results are reinforced by the findings that the linear relationship between the  $VO_2$  at VT and at the LP, EQ and NEG stages of the TT are very similar, both in pattern and strength of correlation.

The TT as a subjective measurement of exercise intensity has been used as a tool for measuring exercise intensity. An advantage of using the TT is that it is considered a threshold-based approach. A threshold-based approach to measuring exercise intensity has been found to be better than a range-based approach because it is based on the uniquely individual physiology of a person (Mezzani, 2012). When studying children, talking became too difficult (NEG) for the children when they were performing above

their VT. In addition, the children were able to speak comfortably and exercise simultaneously when below their VT. This demonstrates that when children are exercising at a level where talking is comfortable, it is likely that they are performing at a level under their VT. Exercising at the EQ stage of a TT has been found to be within the recommended limits of exercise intensity by ACSM (Dehart-Beverley, Foster, Porcari, Fater, and Mikat, 2000). These conclusions indicate that the TT is a reliable indicator of exercise intensity in adults (Woltmann et. al., 2005) and children (Giddings, 2018).

The NEG stage of the TT has been found to be a marker of respiratory compensation threshold (RCT) (Recalde, 2002). However, since the subjects did not achieve an identifiable respiratory exchange ratio, there may have been a lack of maximal effort. This could have been due to the repetitive readings and lack of enjoyability of the test. Some subjects may not have had a regular active lifestyle which could have resulted in a low exercise capacity.

An alternative approach, which was not used in the present study, was to measure the direct reproducibility of the results, as demonstrated by Ballweg et. al., (2013). In that study, subjects performed two exercise tests with gas exchange and two exercise tests with the TT, and responses were compared at physiologic thresholds and TT stages on a subject by subject basis. We chose, instead, to look at replicability by comparing the group responses in this study to the group responses in a different, but similar, group of subjects. Both methods are potentially valuable approaches to support the validity of the TT method. We did not feel that we could reasonably get children of this age to participate in four independent exercise tests.

## **CONCLUSION**

Direct replications serve to validate the results and inspect reliability, with the goal of increasing or reducing the degree of confidence in the originally reported result (Halperin, et. al. 2018). The aim of this study was to increase confidence and reliability of the TT when used with children. The result of no significant differences amongst the current data and the Giddings (2018) data identifies replicability in use of the TT with children. The results from this study and the results from Giddings, 2018 propose that exercising children at a level where speaking starts to become uncomfortable is the key to knowing that children are exercising at or below their VT. This replication study has increased the confidence of using the TT as a measurement of exercise intensity in children.

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APPENDIX A  
INFORMED CONSENT AND ASSENT FORM

Title: The Talk Test as a Measurement of Exercise Intensity in Children

***~ Why you have been asked to take part in this research?***

You are being asked to participate in this study because of the age range you fall into. This research involves the use of children to further understand the effectiveness of the Talk Test. Joining this study is completely voluntary and you are free to leave when you desire.

We have attempted to write this consent form as clearly as possible for your understanding. Feel free to ask as many questions as you wish about this consent form, the procedures, and any information that you do not understand. Study personnel will explain all the procedures that you will be asked to follow.

Research has been done, previously, on the Talk Test, and results show that exercise intensity can be accurately and appropriately measured. Research has not yet been done on children, which has lead us to conduct this study. The purpose of this study is to examine the Talk Test and its ability to accurately and appropriately measure exercise intensity in children.

***~ How many people will be in the study, and for how long?***

The researchers are looking for between 12 and 20 children, aged eight to twelve, to be involved in this study. While the study may take up to eight months to complete, your participation will span only three hours on three separate occasions. There will be three meetings with the researches, each one lasting one hour.

***~ What will happen if you agree to take part in this study?***

Each participant will meet with the researchers on three separate occasions, each one lasting about one hour. The first meeting will be to measure descriptive characteristics, become oriented to the lab, practice running on the treadmill, wearing the gas-analyzer mask (similar to a scuba mask), and reading the Rainbow Passage for practice. After orientating to equipment, each participant will take part in the Talk Test. This will consist of the child walking on the treadmill, which will increase in speed and grade as the test progresses. Each stage of the test will be three minutes long, with the last thirty seconds requiring the child to read a passage at their reading level. The child will then be asked if they can speak comfortably. The second meeting will involve an exercise test where the child will run until he or she feels like she can go no further. The mask will be worn during this test to measure the gas exchange during exercise. The last meeting will consist of an interval session. The child will run until they feel like they can no longer run and will then be brought down to two minutes of rest and then back into intervals.

***~ What are the potential risks associated with this study?***

Risk or discomfort with participation is minimal. The exercise test is maximal test, but has very little risk of injury or event. Small discomfort may be experienced towards the end of the test as exercise becomes more will have the option to stop at any time.

***~ What are the benefits associated with this study?***

There is unlikely any benefit to this study, other than a greater understanding of the child's exercise capacity. The information obtained from this study, though, will go on to improve knowledge within the field of exercise. What if I do not want my child/myself to participate in this study? This study is completely voluntary, and there are no consequences to doing so. Your child/you can withdraw at any time during the study.

**Informed Assent Form (Required for Age 11 through 17)**

- **Child/Adolescent's Understanding:**

Have all your questions regarding how the research study might affect you been answered? Yes / No (Circle one)

If you want to be part of the study, please sign your name. If you do not want to be part of the study, then do not sign your name. **You can say no to being in the study, and you will not be disliked or treated differently.**

\_\_\_\_\_  
Child/Adolescent's Signature

\_\_\_\_\_  
Date of Signature

\_\_\_\_\_  
Printed Name of Subject

- **Parent's/Court-Appointed Guardian's Understanding:**

Have all your questions about how the research study is going to affect your child and/or yourself been answered? Yes/No (Circle one)

I believe my child is fully informed and is willing to participate in this study.

\_\_\_\_\_  
Parent's/Court-Appointed Guardian's Signature

\_\_\_\_\_  
Date of Signature

- **Investigator/Presenter:**

I have discussed this study and the possible risks and benefits of the study with the child, and I believe he/she is fully informed and is willing to participate in this study.

\_\_\_\_\_  
Presenter's Signature (Investigator or Designee)

\_\_\_\_\_  
Date of Presentation

- *What does signing this consent form mean?*

A signature indicates that:

- You or your child has read the above.
- You or your child has freely decided to take part in the research study described above.
- The studies general purposes, details of involvement and possible risks and discomforts have been explained to you and your child.

You and your child will receive a signed copy of this consent/authorization form.

\_\_\_\_\_  
Signature of Subject (If 18 or older and able to give informed consent)      Date

\_\_\_\_\_  
Printed Name of Subject  
•••• **OR** ••••

\_\_\_\_\_  
Signature of Parent (if subject is less than 18)      Date of Signature  
•••••• **OR** ••••••

Health Care Agent as Designated by Power of Attorney For Health Care (if participant is 18 or *older*)

•••••• **OR** •••••• Court-Appointed Guardian (**Circle appropriate title**)

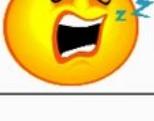
Reason subject was unable to give informed consent:  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Signature of Presenter      Date of Signature

\_\_\_\_\_  
Printed Name of the Above Signature

APPENDIX B  
RPE SCALE

## Rating of Perceived Exertion Chart (Cardiovascular Endurance)

#10		<b>I am dead!!!</b>
#9		<b>I am probably going to die!</b>
#8		<b>I can grunt in response to your questions and can only keep this pace for a short time period.</b>
#7		<b>I can still talk but I don't really want to and I am sweating like a pig!</b>
#6		<b>I can still talk but I am slightly breathless and definitely sweating.</b>
#5		<b>I'm just above comfortable, I am sweating more and can talk easily.</b>
#4		<b>I'm sweating a little, but I feel good and I can carry on a conversation comfortably.</b>
#3		<b>I am still comfortable, but I'm breathing a bit harder.</b>
#2		<b>I'm comfortable and I can maintain this pace all day long.</b>
#1		<b>I'm watching TV and eating bon bons.</b>

APPENDIX C  
READING PASSAGES

# Reading a-z Fluency Passage

Level M

Name \_\_\_\_\_

Tip the Pouncer  
Word Count: 104

Tip, the cat, heard voices. Someone was coming home, 9  
and Tip wanted to play. Anna came through the door. 19  
Tip jumped up on Anna. "I will play with you, Tip," said 31  
Anna. "But you cannot pounce on me." 38

Dan walked in, and Tip jumped up on him. "Stop it, Tip!" 50  
said Dan. "Let's play something else." 56

Tip wanted to pounce. He pounced on a ball of string. He 68  
pounced on a pair of socks on the floor. Tip loved to play. 81

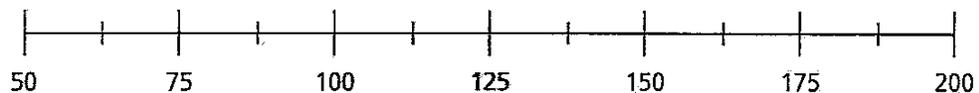
But all that playing made Tip sleepy. "Come here, Tip," 91  
said Dan and Anna. Tip curled up between them and 101  
went to sleep. 104

Number of Errors 

1	2	3	4	5	6

Accuracy (%):

Reading Rate (Words Per Minute):



# Reading a-z Fluency Passage

Level M

One Big Storm  
Word Count: 106

Name \_\_\_\_\_

In 1978, a big winter storm hit Boston, Massachusetts. 9  
The winds blew over 35 miles an hour. Over two feet 20  
of snow fell in one day. The plows could not keep up. 32

The snow fell so fast that cars were left in the middle of 45  
the roads. People had to walk away from them. Many 55  
people had to stay at work. They could not get home 66  
because the roads had too much snow. 73

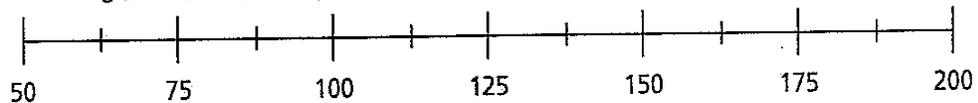
The heavy snows knocked down power lines. Many 81  
people had no heat. It took over two weeks to get the 93  
roads plowed and the power lines back up. It was one 104  
big storm! 106

Number of Errors 

1	2	3	4	5	6

Accuracy (%):

Reading Rate (Words Per Minute):



# Reading a-z Fluency Passage

**Level M**

Name \_\_\_\_\_

Mars  
Word Count: 100

If you get a chance, look at Mars through a telescope. 11  
Mars is the fourth planet from the Sun. It is smaller than 23  
Earth and has two moons. 28

Mars is called the Red Planet because it is covered with 39  
red rocks and dirt. There are even dust storms there! You 50  
might also see an ice cap. People think that Mars used to 62  
be like Earth. There are signs that there used to be rivers. 74  
Now the rivers are dry. 79

People still do not know if there is or was life on Mars. 92  
Would you like to make Mars your home? 100

Number of Errors 

1	2	3	4	5	6

Accuracy (%):

Reading Rate (Words Per Minute):



# Reading a-z Fluency Passage

Level M

Name \_\_\_\_\_

Soccer  
Word Count: 105

Soccer is a great game for girls and boys. You play 11  
soccer with a soccer ball. You play soccer on a field. 22  
There is a net at each end of the field. There are eleven 35  
players on a team. 39

During the game, each team tries to get the ball into 50  
the other team's net. Each time the ball gets into the 61  
net, it is one point. The team with the most points 72  
wins. You can kick the ball in with your feet. You can 84  
hit the ball in with your head. You can hit the ball in 97  
with your knees. Girls and boys everywhere like to 106  
play soccer! 108

Number of Errors 

1	2	3	4	5	6

Accuracy (%):

Reading Rate (Words Per Minute):



APPENDIX D  
REVIEW OF LITERATURE

## REVIEW OF LITERATURE

### *Introduction*

According to the Centers for Disease Control and Prevention (CDC), childhood obesity prevalence has been a severe problem in the United States. In 2015 to 2016 obesity among U.S. youth was 18.5%. Obesity is described as an epidemic in the U.S. The CDC recommends maintaining a healthy diet and participating in physical activity (PA). The CDC and American College of Sports Medicine (ACSM) both recommend specifically including 60 or more minutes of aerobic activity, including three days of vigorous-intensity aerobic activity for children and adolescents. With the need for vigorous intensity aerobic activity, it is important to be able to know exactly when PA is vigorous. Physiologic exercise response tests are completed to determine the intensity of exercise and exercise capacity of a participant. These tests of physiological response and exercise intensity are easy to measure in a clinical setting because of the readily available equipment. In a non-clinical setting, it would be difficult to know intensity of PA without being hooked up to monitoring equipment. Consequently, subjective measures for exercise intensity have been introduced to lessen the burden of using expensive equipment. Subjective tests allow for simple questions (i.e. “How hard was your workout?” “Are you able to speak comfortably?”) to be asked about intensity and the relative physiologic responses correlated with said answer. This simplicity of subjective measures sparked the foundation for the Talk Test (TT).

### *Physiologic Responses and the Talk Test*

In 1998, Goode, Mertens, Shaiman, and Mertens discovered that if someone could hear how heavy they were breathing during exercise correlated with at or near their ventilatory threshold (VT) and at relatively 60%-90% of maximum oxygen consumption. A significant decrease in oxygen consumption ( $\text{VO}_2$ ) is caused by speech production when

exercising (Meckel, Rotstein, & Inbar 2002). The result of the need to acclimate to a comfortable breathing pattern in order to produce speech sounds when exercising causes a decrease in total ventilation,  $VO_2$  and  $VCO_2$  and an increase in blood lactate levels (Doust & Patrick, 1981; Meckel et al. 2002; Rostein, Meckel & Inbar, 2004). Breathing frequency is suppressed due to the lack of  $VO_2$  concentration when speech is occurring. The body will compensate for the loss of  $VO_2$  by increasing the breathing frequency to get more oxygen to the muscles when exercising as well as expel the pooled  $VCO_2$ .

### ***Ventilatory and Lactate Threshold Relationship with Talk Test***

Exercise physiologist Martti Karvonen is remembered today as an important influencer on cardiovascular disease epidemiology and prevention. Karvonen stated that exercise intensity should be in relationship with heart rate reserve (HRR) to allow for individuality. The problem with exercising for HRR is that the results cannot be found without the use of metabolic measuring equipment. HRR can also be used to find an individual's maximum oxygen uptake and measurement of metabolic equivalent. These measurements are not readily available for people to use when exercising to know what intensity they are exercising at. The simplicity and convenience of the Talk Test is an ideal way to identify exercise intensity as well as ventilatory and lactate thresholds.

### **Ventilatory threshold**

High level of ventilatory control is important to maintain normal speech function (Dehart-Beverley, Foster, Porcari, Fater, & Mikat 2000). Ventilatory control is lost once breathing frequency levels increase above the VT. Dehart-Beverley et al. (2000) discovered that ventilatory threshold can be defined with the Talk Test. When the subjects were above VT then they would no longer be comfortable speaking. If a subject could speak comfortably or equivocal, they were at or below their VT. The results of this

study emphasized that the TT could be used to identify VT without the use of expensive metabolic equipment. Conclusions from Recalde et al. (2002) found that the last positive (LP) from the TT results in exercising at intensities below the subject's VT. Respiratory compensation threshold can be found by using the TT. RCT is representable at the time when speech is clearly uncomfortable due to the exercise intensity. During the stage where talking is uncomfortable is known as the negative stage of the TT. Aerobic and anaerobic changes occur in the body during the negative stage. This adjustment in the body creates a need for adenosine triphosphate to be produced aerobically in order to supply enough energy for the body to exercise. In 2011, Quinn and Coons compared the lactate threshold (LT) and VT during different stages during the TT. The researchers confirmed that the TT results strongly suggest that the LT, not VT, reflects the positive and equivocal stages during the TT. Evaluation also demonstrated that exercising below the LT can be used to increase the LT and aerobic power.

### ***Measurement of Exercise Intensity and TT***

Health and fitness benefits are increased when intensity increases during exercise. In order to improve  $VO_{2max}$  the general public should be able to “hear their breathing” but still “be able to talk” (Goode, 2008). The TT has been demonstrated as a monitoring tool for controlling exercise intensity (Woltmann et al., 2015). The practicality of the TT has been an attractive element of the TT in field situations due to the use of no equipment needed. Wotlmann et al. (2015) found that when athletes could speak comfortably they were below their VT and when above VT they were no longer able to speak. When participants are no longer able to speak they are at their respiratory compensation threshold. The ACSM Guidelines suggest avoiding the usage of heart rate-derived measurements due to the overestimation and underestimation of exercise intensity levels.

Instruction of exercise intensity is simplified during the TT due to the strong correlation between LP stage and thresholds for intensity.

### ***Prescribing Exercise Using The TT***

When prescribing exercise, it is important to identify what intensity is to be issued due to the individuality of exercise thresholds. The TT has been seen as an excellent source when it comes to prescribing exercise. Woltmann et al. (2015) found that the TT can point out exercise intensities between acceptable ranges made by the American College of Sports Medicine (ACSM). Persinger et al. (2004) looked at the consistency of the TT for exercise prescription in healthy adults. The results found that the TT identifies VT on both the treadmill and bike. When athletes were above VT, TT reports were negative and the subject could no longer speak. This reliable result suggests that the TT is a dependable method for exercise prescription. Fitness training has been accustomed to match performance with % maximal METs and or % maximal HR (Jeans, Foster, Porcari, Gibson, and Doberstein, 2011). Recent findings have suggested that organization of prescribing exercise can be based on the percent of time above or below the physiologic markers of VT and LT. Jeans et al., (2011) concluded that exercising at the intensity at the last time the participant said they could speak comfortably (LP) is an appropriate steady state training intensity just below the VT. A study by Porcari et al. (2017) compared the TT and heart rate reserve (HRR) as an exercise prescription. The procedure of this research allowed the TT to be used as a tool for guiding exercise training intensity. The data suggests that no difference is made when following %HRR of the TT.

### ***Special Populations***

#### **Cardiac Patients**

Endurance training has been shown to be an effective method for improvement in physical fitness in older adults (Fabre, Massé-Biron, Ahmaidi, Adam, & Préfaut, 1997).

Since training intensities are different in everyone it is important to identify the individual's intensity threshold. As stated before, HR-derived and VO<sub>2</sub> measurements often overestimate or underestimate intensity and is not individualized. Fabre et al. (1997) provided guidance that exercise prescription should be individualized towards the level of VT to be effective for cardiorespiratory fitness. In a clinical setting it is effective to administer the TT due to its availability Cannon et al. (2004) looked at the TT as a measure of exertional ischemia in patients with coronary artery disease. The results of the study helped to identify exercise limits for safety in cardiac patients. Cannon et al. (2004) suggests that exercising should be set at a comfortable enough level where patients can still talk to avoid myocardial ischemia. Research was then continued on to specifically test ventilatory threshold in cardiac patients in research by Voelker et al. (2002). Results from Voelker et al. (2002) show that the TT is applicable due to the marker of ventilatory threshold for exercise intensity. Zanettini et al. (2012) discovered the validity of the TT when exercise prescription is proposed to patients with myocardial revascularization. The last positive before VT was found to optimize aerobic training intensity when the TT was given to cardiac patients. A majority of the studies that looked at the relation of the TT and Cardiac patients have found that the TT is mostly reliable and valid to prescribe intense training activity in a safe and effective way.

### ***Exercise in Children***

#### **Ventilatory Threshold and Blood Lactate Levels**

The TT has not been applied to intensity exercise in children until 2018 by Peter Giddings (Giddings, 2018). Exercise behavior in children has been reviewed through maximal exercise testing. A review of ventilatory threshold in children was completed by Mahon & Cheatham (2002). VT has been shown to be a reliable event in graded exercise

in children. A trend was seen in VT that continued to decline as the children aged from five to 12 years of age. It is imaginable that the changes in both VT and VO<sub>2</sub> max were due to training adaptations associated with recreational activities and not purely affects from growth and development. Blood lactate levels were revealed to be lower when exercising when compared to adults exercising at the same intensity (Mahon, Duncan, Howe, & Del Corral, 1997). Higher lactate levels allow children to exercise at or above their ventilatory threshold for a longer amount of time.

#### RPE for Children

RPE has been used to evaluate the measure of exercise intensity in children (Mahon, Plank, & Hipp, 2003). Multiple studies have found that the RPE scale could be improved to allow for children to better understand. Using a regular RPE scale on children has been found to have limitations in children younger than 11 (Utter, Robertson, Nieman, & Kang, 2002). Children had a difficult time assigning numbers to words or phrases that describe an exercise feeling. They also had a difficulty interpreting certain verbal scale descriptors that were not at their reading or comprehension level. Thus the OMNI scale was invented and provided user friendly variables such as pictures, colors, and statements that correlate with the exercise stage. Conclusions by Rice, Gammon, Pfeiffer, & Trost, (2015) found that the OMNI scale resonated well with children aged six to 15 years old.

#### ***Conclusion***

The Talk Test has been seen as a measure of exercise intensity in many different populations. The validity and reliability of the test has often been found substantial and dependable. The simplicity of the Talk Test has become an attractive measure for exercise intensity since no money is needed to spend on the test. The Talk Test measures important physiological responses that can be utilized just by the allowance of

recognizing speech comfortability. The Talk Test should be adaptable for children due to the current epidemic of childhood obesity. Children will be able to apply appropriate exercise intensities by using the Talk Test. A direct replication of studying the Talk Test in children will allow for a validation of results and an inspection of reliability to increase the confidence in previous results.

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