ABSTRACT

Title of Thesis: THE CORRELATION BETWEEN PSYCHOLOGICAL TYPE AND PERFORMANCE TIME WHILE WEARING A RESPIRATOR

Franklin Chong Suk Koh, Master of Science 2004

Thesis Directed By: Dr. Arthur Johnson, Biological Resources Engineering

The brain efficiently utilizes dominant templates to think, learn, create, solve problems, and communicate. Many studies have shown that individuals perform better if not wearing a respirator than with wearing a respirator. This study examined the degree of performance reduction attributable to specific dominant character traits. The subjects performed on a treadmill at a constant speed and grade resulting in 80-85% of maximum oxygen consumption (VO_{2max}). A modified M40 respirator was used to create three levels of inspiratory resistance: 2.78, 16.79, and 27.27 cmH_2O*(sec/L). The 31 subjects were tested using a Myers-Briggs Type Indicator (MBTI) and State-Trait Anxiety Inventory (STAI). Multiple regressions and an ANOVA were used to test for correlation. When air intake is very constricted, the multiple regression that was found to be statistically significant was sensing-intuition (how one takes in information) and thinking-feeling (how one makes a decision) versus performance time with 27.27 cmH_2O*(sec/L) inhalation resistance.

THE CORRELATION BETWEEN PSYCHOLOGICAL TYPE AND PERFORMANCE TIME WHILE WEARING A RESPIRATOR

By

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Dedication

To Mom, Dad, Brothers, and Grandmother

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List of Symbols

Abs Slope	Absolute Slope
Age	Age (years)
ANOVA	Analysis of Variance
Anxiety	Trait Anxiety
Avg	Average
CO_2	Carbon Monoxide
CSAI-2	Competitive State Anxiety Inventory-2
E	Extraversion
EI	Extraversion-Introversion
F	Feeling
FEV_1	Max Volume of Air Exhaled Within One Second
HBDI	Hermann Brain Dominance Instrument
Height	Height (cm)
HPI	Hogan Personality Inventory
HR	Heart Rate (beats/min) taken Every Minute
I	Introversion
J	Judging
JP	Judging-Perceiving
KSP	Karolinka Scales of Personality
Max	Maximum
MaxHR	Maximum Heart Rate During VO_{2max} Test.
MaxVO2	Max Oxygen Consumption during VO_{2max} Test (L/min)
MBTI	Myers-Briggs Type Indicator
Min	Minimum
MMPI	Minnesota Multiphasic Personality Inventory
$MVV_{.25}$	Quarter of 1 Minute Maximum Voluntary Ventilation
N	Intuition
NASA	National Aeronautics and Space Administration
NormVO2	Normalized VO_{2max} in respect to weight (ml/min/kg)
O_2	Oxygen
P	Perceiving
PCI	Personality Characteristic Inventory
$P_{ET}CO_2$	End Tidal Partial Pressure
Post R1 St	R1 Condition Post STAI Score

Post R2 St	R2 Condition Post STAI Score
Post R3 St	R3 Condition Post STAI Score
Pre R1 St	R1 Condition Pre STAI Score
Pre R2 St	R2 Condition Pre STAI Score
Pre R3 St	R3 Condition Pre STAI Score
R1	Orifice with 2.78 cmH_2O*(sec/L) Resistance at 85(L/min)
R1 Percent	R1 Condition VO_{2max} ÷ VO_{2max} during VO_{2max} Test (%)
R1 Time	R1 Resistance Performance Time (sec)
R1Dif	R1 Condition Post STAI Score – R1 Condition Pre STAI Score
R1VO2	R1 Condition Maximum Oxygen Consumption (L/min)
R2	Orifice with 16.79 cmH_2O*(sec/L) Resistance at 85(L/min)
R2 Percent	R2 Condition VO_{2max} ÷ VO_{2max} during VO_{2max} Test (%)
R2 Time	R2 Resistance Performance Time (sec)
R2Dif	R2 Condition Post STAI Score – R2 Condition Pre STAI Score
R2VO2	R2 Condition Maximum Oxygen Consumption (L/min)
R3	Orifice with 27.27 cmH_2O*(sec/L) Resistance at 85(L/min)
R3 Percent	R3 Condition VO_{2max} ÷ VO2max during VO_{2max} Test (%)
R3 Time	R3 Resistance Performance Time (sec)
R3Dif	R3 Condition Post STAI Score – R1 Condition Pre STAI Score
R3VO2	R3 Condition Maximum Oxygen Consumption (L/min)
S	Standard Deviation if on the figure next to R^2 or $R^2_{adjusted}$ or P_{value}
S	Sensing if x or y axis of a plot or in sentences
Sex	Gender of the individual Female = 0, Male = 1
SFS	Suffocation Fear Scale
Slope	Resistance Sensitivity (sec/(cmH2O*sec/L)) = Slope of Performance Time vs. Inhalation Resistance
SN	Sensing-Intuition
STAI	State-Trait Anxiety
Stdev	Standard Deviation
Subj	Subject #
T	Thinking
TF	Thinking-Feeling
TRAIT	Trait Anxiety Score (Range of Score 20-68)
Var	Variance
V_E	Minute Ventilation Sampled Every 30 Seconds
VeSTPD R1	R1 Condition Maximum Minute Ventilation (L/min)
VeSTPD R2	R2 Condition Maximum Minute Ventilation (L/min)
VeSTPD R3	R3 Condition Maximum Minute Ventilation (L/min)

VI_{max}	Maximum Forced Inspiratory Flow
VO_2	Oxygen Consumption Sampled Every 30 Seconds
VO_{2max}	Max Oxygen Consumption
Weight	Mass of the Individual (kg)

Chapter 1: Justification

1.1 General Introduction

Historically, the U.S. military has used personality assessments as a screening device to identify soldiers at risk for debilitating psychological problems when faced with combat (MacCluskie, et. al., 2002). Although many facets of personality testing have been developed and applied in discerning and predicting certain effects (such as sport-specific performance, drugs, external stimulus, and cognitive abilities), correlation between personality trait and performance time while wearing a respirator has not been determined. According to Harber et. al. (1988), the reasons why some individuals find respiratory protective devices intolerable may be psychological. Johnson et. al. (1995) also showed that some people might be more psychologically sensitive to the physiological affects of the mask. A correlation between psychological personality types and performance time while wearing a respirator of different resistances would be useful in identifying specific individuals whose personality may be predisposed to be intolerant of respirators. This prescreening process could then assist in tailoring training designs to aid in increasing the individual's psychological comfort and tolerance of the respirator. Learning designs may have to factor in the uniqueness of the individual learner to properly convey intended meanings in terms of comprehension. In light of heightened alerts of terrorist activities, military and first-responders could benefit from utilizing a personality trait predictive test for discerning work performance for a specific workload while wearing a respirator. This prescreening technique could also allow managers to compensate for performance reduction by assigning more help for a given task or situation. Identifying the specific personality trait that correlate highly with an individuals resistance sensitivity or performance time may save lives.

Johnson et. al. (1995) designed an experiment to test how much of the performance decrement was attributable to the degree of anxiety of the individual wearing a respirator. Twenty subjects were tested for anxiety levels while each performed on a treadmill at 80-85% of their maximum heart rates until volitional termination with and without a respirator. This experiment accounted for many variables including the respirator weight by using a backpack of equal weight for the non-respirator condition. On the average, performance time without the respirator was more than with the respirator; less anxious people experienced less discomfort and performed longer than more anxious people.

Another study by Johnson et. al. (1999) showed that performance time decreased linearly with resistance level, and no threshold resistance value was apparent. Twelve subjects walked on a treadmill while wearing a modified M17 respirator with six levels of inspiratory resistance ranging from 0.78 to 7.64 cmH_2O*(sec/L). The speed and grade on the treadmill remained constant to obtain 80-85% VO_{2max}. When each individual's performance time vs. resistance was observed, the slopes of the lines were unique to each individual. Three of the 12 subjects were largely unaffected by the high resistances and showed a low sensitivity to the highest inspiratory resistance of 7.64 cmH_2O*(sec/L). No physiological features were found that distinguished this group of subjects from the rest.

In order to narrow the search for the specific distinguishing uniqueness that correlated sensitivity to inspiratory resistance, the goal of this thesis was to determine if there was a correlation between psychological type and performance time while wearing a respirator. Additionally, physical attributes such as height, weight, age, sex, and overall physical condition were recorded. Johnson et. al. (1995) and Morgan and Raven (1985) evaluated Anxiety score with performance time while wearing a respirator but this thesis will further investigate how personality trait defined by MBTI relates to respirator performance time.

1.2 Justification of Performance Time

Because sensitivity to resistance has been defined by the slope of performance time vs. various inhalation resistances, performance time at a particular resistance was tested for correlation with resistance sensitivity. Preliminary analysis of Johnson et. al.'s (1999) data showed some correlation between performance times and sensitivity to resistance levels. However, to further test the significance of performance time and sensitivity to resistance, three different orifices with a wide range of inhalation resistances 27.27, 16.79, and 2.78 cmH_2O*(sec/L) (respectively R1, R2, R3) were used to elicit a performance duration decrement.

Analysis of the test subjects showed a high correlation (R^2=0.943) between performance time at the lowest inhalation resistance and sensitivity to resistance. This is shown in Figure 1 as the slope of performance time vs. slope. Surprisingly, the longer a person ran at the low inhalation resistance, the more likely the higher resistance level affected that person. This relationship between performance time at the lowest inhalation resistance and resistance sensitivity was analyzed in conjunction with the primary objective of this thesis. With the lowest inhalation resistance, most subjects did not complain of respiratory discomfort but complained of claustrophobia. Further studies should be conducted to see if the lowest resistance produced insignificant decrement of performance time attributable to difficulty inhaling.

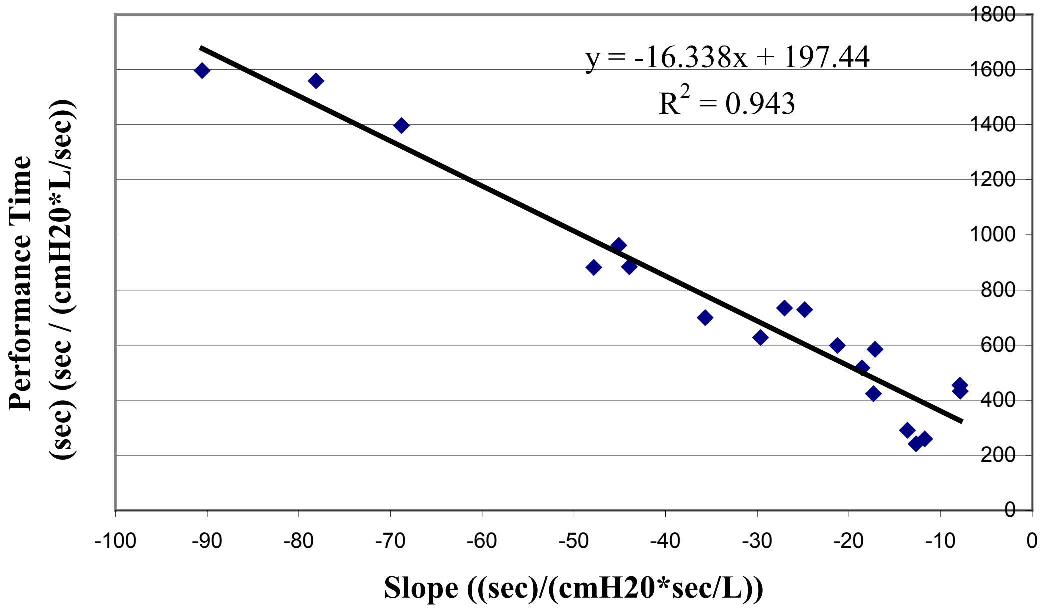


Figure 1. At the lowest resistance R1 (2.78 (cmH2O*(sec/L)) inhalation resistance performance time shows a linear relationship to sensitivity of resistance (slope of performance time vs. inhalation resistance).

This direct relationship between performance time at the lowest inhalation resistance and sensitivity to resistance has also been characterized in other studies. In general, most fit individuals tended to have greater endurance and could physically perform for a longer time than unfit individuals. Lindstedt et. al. (1994) showed that the orifice diameter that caused a reduction in oxygen uptake was over two times larger for athletically trained subjects than for untrained, corresponding to about a four-fold difference in resistance at any flow rate. In essence, trained individuals (high VO_{2max}) were more affected by inspiratory loading or resistance than untrained individuals (low VO_{2max}). With respect to performance time, when there was low inspiratory resistance, fit individuals ran longer than unfit individuals. Conversely, with high inspiratory resistance, the trained individuals were most affected by the higher resistance. This research builds on the premise that individuals with excellent endurance or long performance times should be most affected by higher resistances. The findings of this study could influence how to discern individuals who may be most affected by higher resistances. With that, customary endurance time while exercising could be one contingency to discern individuals with sensitivity to resistance.

1.3 Inhalation Resistance Selection

1.3.1 Physiological responses to using Inhalation Resistance

Louhevaara (1984) used resistances with pressure drops ranging from 0.4 to 5.1 kPa at air flow rates of 1.0-2.01 L/s (2.8-36.83 cmH_2O at 85 L/min) to test physiological responses to inhalation resistance at low intensity work rate and 80% VO_{2max}. The results showed that inspiratory breathing resistance added during sub-maximal and maximal exercise hindered ventilation and resulted in hypoventilation and retention of CO_2. Silverman et. al. (1945) investigated the effects of inspiratory resistance (0.6-10.6 cmH_2O at a flow rate of 85 L/min) on breathing while working on a bicycle ergometer for 15 minutes at various work rates (0-1660 kg*m/min). The experiments showed that increased respiratory resistance resulted in decreased submaximal oxygen uptake and ventilation volume with increased respiratory exchange ratio. He concluded that oxygen debt increased with inhalation resistance (Silverman et. al., 1945). Lerman et. al. (1983) concluded that increased inspiratory resistance led to significantly decreased physical performance, decreased tidal volume, increased ratio of inspiratory to expiratory time, increased peak inspiratory pressure, and increased CO_2 retention in the alveoli. If inhalation resistance caused O_2 debt or CO_2 storage, the highest resistance should be a major factor in determining whether a person would be sensitive to inhalation resistance. Deno et. al. (1981) showed increases in end tidal partial pressure of CO_2 ($P_{ET}CO_2$) with simultaneously increased inhalation and exhalation resistance conditions above 16 cmH_2O pressure at a flow rate of 120 L/min (assuming a linear interpolation of 11.33 cmH_2O at 85 L/min). The subject's inability to tolerate higher blood CO_2 concentrations during prolonged exercise suggested that CO_2 could play a role in the decrement in maximum exercise performance during prolonged work.

The following sections detail the reasons for selecting the inhalation resistance conditions. Inhalation values were chosen by analyzing resistance values and the performance time projected by the least squares regression line drawn through the means of the data. The performance time was determined by (Johnson, et. al., 1999):

$$\text{Time} = 15.1 - 1.32\ (\text{Resistance}) \qquad (1)$$

where time was in minutes and resistance was in cmH_2O*(sec/L). The resistance (slope of pressure vs. flow curve) was described at the standard flow rate of 85 L/min. Often, the pressure caused by the orifice has been characterized at a flow rate of 85 L/min (Johnson, et. al., 1999).

1.3.2 Experimentally measured Inhalation Resistance

For this research, three different inhalation resistances (R1=2.78, R2=16.79, and R3=27.27 cmH_2O*(sec/L)) were used and the only variable that changed for each of the conditions was the inhalation orifice. Each of the orifice pressure vs. flow characteristics of Figure 2 were directly measured using a Fleisch #3 flow meter and Validyne pressure transducers in series with a vacuum source. The pressure was measured near the upper lip of the medium sized metal head form.

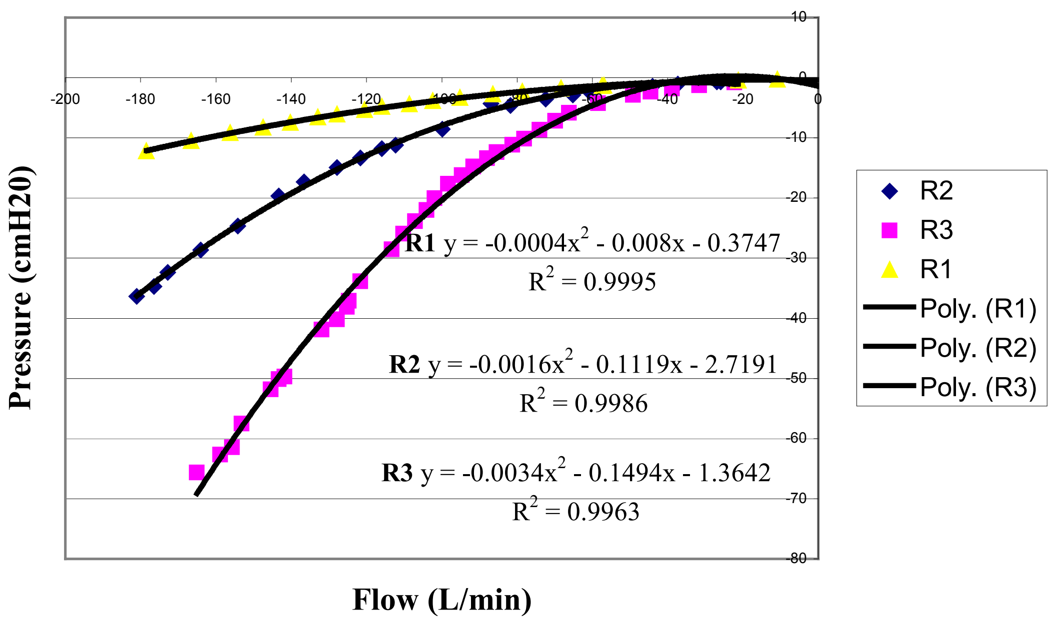


Figure 2. Characteristic pressure flow curves of R1, R2, and R3 resistances. At 85 L/min, respective resistances of 2.78, 16.79, and 27.27 cmH_2O*(sec/L) were determined.

1.3.3 Minimum Resistance (R1)

In Johnson et. al.'s (1999) experiment, most of the subjects who ran at the lowest inhalation resistance terminated testing at 80-85% VO_{2max} due to the following reasons: fatigue, pain, simple boredom, or other physical discomfort usually attributable at this intensity of exercise. At the minimum inhalation resistance, performance degradation was normal fatigue or exhaustion brought on by the intensity of exercise. In order to eliminate the normal fatigue factor in the study, a duration time that most people could tolerate at low resistance was established. Once this time duration was established, the effect of higher inhalation resistance could be isolated and identified as the contributor to performance time. The minimum critical pressure or threshold pressure that most subjects found comfortable was below 0.39 kPa measured at a flow of 85 L/min (3.96 cmH_2O*sec/L at 85 L/min) (Caretti and Whitley, 1998). The study indicated that inspiratory resistance at this level did not significantly influence exercise performance time during constant load work of 80% $VO_{2max.}$ Similarly, Yasukouchi and Sarita (1989), indicated that most Japanese workers who used respiratory protective devices changed the filter at a resistance between 3.0 and 4.5 cmH_2O*(sec/L) because it inhibited inhalation. In Johnson et. al.'s study (1999), the performance time with the lowest resistance of 0.78 cmH_2O*(sec/L), which 91% of the subjects (11/12) completed before the onset of exercise-induced fatigue or volitional termination, was six minutes. Correspondingly, at the 3.32 cmH_2O*(sec/L) inhalation resistance condition, 83% (10/12) of the subjects were able to run for about six minutes. This implied that the higher resistance did not contribute significantly to the primary reason for the volitional termination. Because the minimum resistance orifice of 2.78 cmH_2O*(sec/L) at 85 L/min was less than the range stipulated by Yasukouchi and Sarita (1989), this resistance was used for the minimum resistance criterion. In accordance with Equation 1, the theoretical time was 11.43 minutes. Most subjects for this thesis were able to perform for more than 12 minutes at 2.78 cmH_2O*(sec/L). The primary reason for termination was boredom or physical fatigue (pain in joints or ankles) common with 80-85% VO_{2max} exercise duration beyond six minutes.

1.3.4 Maximum Resistance (R3)

The maximum resistance had to be a universal maximum resistance that most people could tolerate for about one minute at 80-85% VO_{2max}. This maximum resistance was necessary to define the best-fit line between the lowest critical resistance and highest critical resistance. Silverman et. al., (1945) stated that, "a limit on the internal respiratory work appears to be the best basis for stating tolerable limits of resistance."

The maximum resistance of an individual was found to be 16.79 cmH_2O*(sec/L) at the workload of 80-85% VO_{2max} as calculated by Equation 1 using Time = 0. Bentley et. al. (1973) concluded that excessive inspiratory pressure was a major factor in determining subjective tolerance and suggested that 90% of subjects breathing through an apparatus with low expiratory resistance should experience no discomfort if the pressure across the apparatus did not exceed 17 cmH_2O. However, for this thesis, most subjects were able to tolerate the 27.27 cmH_2O*(sec/L) condition for one minute while exercising at 80-85% VO_{2max}. As soon as the respirator with 27.27 inhalation resistance was affixed on the face of the subject, most subjects complained of discomfort and an inability to inhale. Perhaps Johnson utilized a maximum inhalation resistance of 7.64 cmH_2O*(sec/L) to not distress the subject with premeditated reasons for termination before exercise. However, for this test, to discern individuals who could not tolerate high resistance, the upper limit of high resistance needed to be used.

One of the primary reasons for volitional termination at the highest resistance was the high airflow restriction. At the highest resistance of 27.27 cmH_2O*(sec/L), the individual was probably feeling the build-up of carbon dioxide, which could possibly indirectly indicate the CO_2 sensitivity of the individual. Thus, performance time while wearing a high resistance could be a function of the individual's sensitivity to CO_2.

1.3.5 Middle Resistance (R2)

Since a larger range of resistance values was preferred in order to derive the slope of performance time vs. inhalation resistance with minimum inconvenience to the volunteers, resistances of 27.27, 16.79, and 2.78 cmH_2O*(sec/L) were utilized to produce an intolerable maximum inhalation resistance, a mid resistance (61.5% of intolerable maximum inhalation resistance), and a minimum resistance, respectively. At 16.79 cmH_2O*(sec/L), most subjects were able to perform for an average of six minutes.

Chapter 2: Literature Review

The following sections focus on different performance times for different physical tasks and how each correlated to the psychological parameters defined by numerous batteries of tests. Sonstroem (1978) postulated that the self-perception of physical ability (estimation) and interest in physical activity (attraction) directly influenced physical performance. Additional subsections include different batteries of psychological tests and physiological responses of inhalation loading.

2.1 Physiological Response to Inhalation Resistance

Inhalation load-sensitive individuals tend to limit the length of time over which the inspiratory muscles are active, thus preventing the normal prolongation of inspiration due to respirator load. A study by Harber et. al. (1988) of eleven normal subjects demonstrated that there was a relationship between breathing pattern and an individual's sensitivity to added resistive loads when stressed by inspiratory load and exercise. Individuals who breathed with relatively lower peak pressures had shorter inspiratory times whereas individuals with lower tidal volumes tended to have greater sensitivity to added loads. He also suggested that respiratory pattern, in addition to muscular ability to generate air flow, was an important parameter to consider in evaluating workers using respirators. However, the scope of the study did not address the maximum time tolerance of the individual to determine if an individual with short inspiratory time and higher frequency of breath endured the higher resistance for a longer duration of time.

2.2 Clinical Pulmonary Function and Performance

Respirators have been shown to affect a person with superior lung function to a greater degree than a person with moderately impaired lung function by evaluation with a battery of clinical pulmonary tests while wearing a respirator. Raven et. al. (1981) showed that effort dependent tests that measured flow characteristics of the lung were more susceptible to change as a result of respirator use. Sixty subjects (12 superior, 37 normal, and 11 with moderate lung function impairment) were subjected to a battery of clinical pulmonary tests while wearing a full-face mask (MSA-Ultravue, Mine Safety Appliances Company, Pittsburgh, PA). Comparisons of these tests were made between the three groups while wearing and not wearing a respirator. According to Raven, clinical tests of 15-second or a quarter of 1 minute maximum voluntary ventilation ($MVV_{.25}$) were best in determining worker capability when wearing an industrial respirator. The study implied that individuals with superior lung function were more affected by respirator resistances.

Wilson and Raven et. al. (1989) used stepwise linear regression analysis to determine the clinical pulmonary function measures that were the best predictors of work performance of 38 subjects. $MVV_{.25}$ with a modified respirator (MSA-Ultravue, Mine Safety Appliances Company, Pittsburgh, PA) was determined to be the best predictor of maximal exercise performance by a significant, positive correlation ($R=0.92$, $p<0.01$) between conditions with and without a respirator. The difference in peak inspired flow (with and without a respirator) was a good predictor of performance time with the respirator during an endurance walk to exhaustion. No variables predicted exercise time on the endurance tests without the respirator, the change in endurance time (with or without a respirator), nor the change in maximal exercise performance time (with or without a respirator). This was expected according to Wilson because the respiratory system was not the limiting factor in exercise performance while not wearing a respirator.

Contrarily, Lindstedt et. al. (1994) compared VO_{2max} and maximum forced inspiratory flow, VI_{max}. VI_{max} was an indirect measure of airway resistance and inspiratory muscle strength, for an optimal design between structure and function with 12 healthy untrained and trained male cyclists. Critical plastic disc orifice sizes were determined (0.87, 0.60, and 0.42 cm in diameter with 0.2 mm thickness) by the extent of ventilation (V_E) or flow reduction of all subjects during exercise. Unfortunately, the actual pressure and flow characteristics that would give the resistance measurements at 85 L/min were never tested for the various orifices (2.12, 1.69, 1.30, 0.87, 0.60, 0.42, and 0.32 cm in diameter with 0.2 mm thickness). The greatest orifice diameter that caused a reduction in oxygen uptake was over two times larger for trained than untrained subjects, corresponding to about a four-fold difference in resistance at any flow rate. However, during forced inspiration through high inspiratory resistances, both trained and untrained individuals showed no difference in peak flows or peak inspiratory power because both the trained and untrained individual flow rates were limited and essentially equalized. This did not conflict with Wilson and Raven's (1989) statement that the difference in peak inspired flow with and without a respirator was a good predictor of performance time because Wilson used a standard resistance, which was not high enough of a resistance to have a equalizing affect on the flow rates between the trained and untrained cyclists. Hence, only the highest flow rate at the low resistance was a significant variable.

Assuming that most individuals who could perform for a long duration had healthy lung function, an athlete's performance time at 80-85% VO_{2max} was assumed to be longer than non-athletes at the lowest resistance. Comparatively, high inhalation resistance could significantly affect the athlete because of the universal normalizing affect of limiting the inhalation flow rate. However, according to Lindstedt et. al. (1994), even though maximum external output maintained for two minutes was 43% greater and V_{O2max} was 49% greater in trained individuals than untrained, VI_{max} did not match up with VO_{2max} in humans. Hence, VO_{2max} could be a better measure of a person's performance time because a high VI_{max} does not mean that the individual would perform for a long duration. If VO_{2max} was used as a measure of an individual's athleticism, then an individual's VO_{2max} could be used to correlate performance time and other psychological and physiological parameters.

2.3 State-Trait Inventory

State-Trait Inventory is widely used to measure anxiety levels of the subjects. According to Morgan and Raven (1985), the State-Trait Inventory scores correctly predicted 83% of the individuals who would stop exercising because of respiratory distress. Respiratory distress was defined as an individual who stopped exercising because of difficulty breathing. All other cases of volitional termination not related to difficulty of breathing were not counted as respiratory distress. Additionally, the trait anxiety score correctly predicted 97% of the subjects who would not experience distress while wearing a full-face mask (MSA-Ultravue, Mine Safety Appliances

Company, Pittsburgh, PA) while working at 35-80% VO_{2max}. Morgan defined a score of 39 or greater to be high anxiety by classifying individuals scoring one or more standard deviations above the sample mean as being elevated on the trait or characteristic of interest. However, Morgan did not analyze for correlation between State-Trait Inventory score and the performance time at each specific inhalation resistance or the slope of performance time vs. resistance.

2.4 Personality Characteristic Inventory

The National Aeronautics and Space Administration (NASA) originally developed a personality battery called the Personality Characteristic Inventory (PCI) to predict individuals who may not be able to cope with stressful environments. The objective of this effort was to identify personality traits that were beneficial in stressful and potentially dangerous environments, so that the success of critical missions could be assured (Sandal, et. al., 1998). Sandal studied personality and endocrine activation in military stress situations. The PCI captured two broad dimensions of personality: instrumentality (goal orientation) and expressivity (interpersonal capacities). Positive instrumentality was characterized by a motivation for achievement, whereas negative aspects of instrumentality were characterized by autocratic, dictatorial orientation. Positive expressivity referred to warmth and sensitivity to others, whereas negative expressivity referred to verbal aggression, passivity, and servility in interpersonal relationships.

Air Force cadets performed two stressful exercises, and serum levels of cortisol and testosterone were measured before and after the exercise. The cadets who were characterized with positive expressivity and instrumentality had lower cortisol levels and larger testosterone-cortisol ratios. In summary, 38 of 44 Air Force cadets were classified by the PCI as being positive in expressivity and positive in instrumentality, indicative of superior coping. Unfortunately, there was no correlation between the PCI score and endurance time or performance time while exercising.

2.5 Predicting Performance Time in a Triathlon

For this research, the focus was on the predictive tests that forecast performance time while wearing a respirator. When an athlete was wearing a respirator with little inhalation resistance, that individual would most likely perform longer on the treadmill at a higher intensity then an unfit or normal individual. For an athlete running a marathon, the more physically fit or well-trained individual would finish the race earlier. Reasoning would dictate that a test that could predict the finishing time of a marathon would inversely predict performance time while wearing a respirator.

Burke et. al. (1996) tested forty seasoned (eight months of training) tri-athletes with a multi-dimensional approach that predicted finishing time of the triathlon events. Psychological, anthropometric, and VO_{2max} protocols were used. The predominant factors that accurately predicted performance were self-efficacy total estimation, performance history, and body weight.

The Competitive State Anxiety Inventory-2 (CSAI-2), State-Trait Anxiety Inventory (STAI), state components and the self-efficacy statement (self approximation of finish time) were used for the psychological protocol. The anthropometric protocol was body composition and the VO_{2max} protocol was performed on an aerobic trainer at a pedaling cadence of 80 rpm at different grades. Significant correlations were only found for performance time and VO_{2max} values.

The performance history and self-efficacy statement showed significance in predicting performance time. Self-efficacy was a self-estimate of each athlete's finishing time. This was later compared to each individual's actual time for each of the three legs of the Australian Ironman Triathlon (swimming, cycling, and running). Previous performance times and body weight (the less weight a person carried, the more oxygen transport to the working muscles) were also factors (Burke, et. al. 1996). Together, self-efficacy, performance history, and body weight correctly predicted 85% of the performance times for swimming, 87% for cycling, and 48% for running. All other variables failed to reach statistical significance. This implied that performance time depended on the person's self-efficacy or confidence and physiological aspects (VO_{2max} and weight). Due to the abundance of evidence that has correlated self-efficacy or positive self-image with physical performance, psychological predominance tests that deal with this particular attribute were not tested for this research.

2.6 Psychological Predictors of Physical Performance and Fitness

McDonald et. al. (1991) also determined that performance time depended on psychological variables (mood scales, physical estimation and attraction, self-concept, and personality scales) when predicting physical performance and fitness of 102 active duty military volunteers. U.S. Navy personnel performed a number of physical performance and fitness tasks with a battery of questionnaires. The study showed that the questionnaire measuring attraction (self image), estimation (self estimate), and physical self-concept scores were the best predictors of physical performance and fitness tasks for both male and female volunteers.

2.7 Myers-Briggs Type Indicator (MBTI)

The MBTI has been one of the most widely used psychological instruments with more than two million people completing the assessment each year. Jung's classic psychological theories provide insight into individual preferences for taking information, organizing and evaluating information, reaching conclusions, and dealing with everyday interactions (Gordon, et. al., 2001). These personality traits have been characterized by four preferences: extraversion (E)-introversion (I), sensing(S)-intuition(N), thinking(T)-feeling(F), and judging(J)-perceiving(P) (Culp, et. al., 2001). Because of its ease to quantify each of the four traits, simplicity, and popularity, MBTI was the personality trait test selected to correlate the performance time of each corresponding resistance while wearing a respirator in this study.

2.8 Personality Dimensions and Job Performance

Barrick and Mount (1991) investigated five personality dimensions (extraversion, emotional stability, agreeableness, conscientiousness, and openness to experience) to job performance criteria (job proficiency, training proficiency, and personal data) for five occupation groups (police, professionals, managers, salesmen, and skilled/semi-skilled workmen). Conscientiousness was a valid predictor for all job performance criteria for all occupational groups. Extraversion was a valid predictor for occupations involving social interaction, including managers and salesmen. Both openness to experience and extraversion were valid predictors of the training proficiency criterion. Different personality tests or theories have used different terms to describe the non-cognitive dimensions of personality.

Barrick's five personality dimensions ("Big Five") are similar to Myers-Briggs (John, 1990). Insurgency or extraversion would be equivalent to extraversion vs. introversion. Agreeableness would be similar to feeling vs. thinking. Conscientiousness would correspond to judging vs. perceiving. Openness to experience would correspond to intuition vs. sensing. However, the Myers-Briggs does not measure emotional stability. Since the PCI test was thought of as an emotional stability measurement and no correlation was made between PCI and physical performance time, the inference has been made that emotional stability may not show any correlation to performance time during exercise. However, the "Big Five" personality dimensions could be useful in future studies.

2.9 Hogan Personality Inventory and Physical Fitness

Hogan (1989) examined the relationship between personality and physical fitness. One group of 97 adult males completed the Hogan Personality Inventory (HPI) and five nationally recognized physical fitness batteries. A second group of 35 adult males used the Minnesota Multiphasic Personality Inventory (MMPI), a test frequently used for police officer selection in Minnesota. The studies indicated that physical fitness had to be defined in "multidimensional terms" related to self-confidence and self-discipline. The MMPI was unrelated to measures of health and fitness, but suggested that toughness and aggressiveness were associated with superior obstacle course performance ($R^2 = 0.46$, $p<0.007$). The MMPI has been the most widely used objective inventory of psychopathology in the world and frequently but not limited to determining whether any empirical relations exist between psychopathology and fitness.

The HPI, a 310-item inventory, was designed to assess six dimensions of normal personality. It measured the following personality dimensions: intelligence (bright vs. dull), adjustment (self-confident vs. neurotic), prudence (conscientious vs. delinquent), ambition (upwardly mobile vs. anergic), sociability (extraversion vs. introversion), and likeability (likeability vs. disagreeable). These scales were composed of 43 homogeneous item composites. Statistical significance using one-tailed t- tests showed that physically fit individuals rarely worried about their health, were perfectionistic, and competitive. They were not self-doubting, depressed, nor nervous. The endurance factor (the most predictable fitness variable) and prudence dimensions were found to be the most extensively involved in fitness.

The above analysis brought up a paradoxical question. Some of the widely known benefits of exercise include self-confidence, feeling of resiliency, and competitiveness. On the other hand, self-assured, robust, and achievement oriented individuals were more likely to exercise to enhance their self-image. Either way, people with a positive self-image, tended to be more confident, happy, and overall more predisposed to be physically fit. HPI may be also useful in future studies.

2.10 Whole Brain Theory (HBDI)

In 1978, Ned Herrmann created the Herrmann Brain Dominance Instrument (HBDI, 2004). Continued research and application of the HBDI led to the development of a comprehensive four-part Whole Brain Model. Although the main independent aspects are the four quadrants of the brain plus Introversion/Extraverion, there are really nine main scores derived from the HBD instrument; Left and Right Dominance, the four scores, Cerebral and Limbic preferences, and Introversion/Extroversion (similar to MBTI). The left versus right brain is useful in measuring an overall left versus an overall right brain dominance without making the cerebral/limbic distinction. The four quadrant constructs are the following: The upper left- preferences of mathematical, technical, analytical, and logical thinking; Lower-Left- deals with an organized, planned, orderly, and step-by step approach and avoidance of risk and novelty; Lower Right- describes the concern for emotions, interpersonal warmth, and feelings, and as an interest in music and communication through speaking, writing and reading; Upper Right- refers to the synthesizing and intuitive modes of thought: holistic, visual, imaginative thinking.   All these aspects are numerically quantified and easily scored. HBDI's personality type measurement closely relates to the MBTI intuition and perceiving scales and feeling vs. thinking scales. Additional constructs that the HBDI relates are speed of logical mathematical processing, visual closure, visual learning styles and strategies. HBDI also permit a person to have an individual brain profile in which a person might prefer to be a thinker and feeler or both a risk avoider and a risk taker at the same time. Because the Whole brain technology covers a broad band of personality criterion that may overlap with MBTI, this makes it a very applicable test for future studies.

2.11 Karolinska Scales of Personality and Fibromyalgics

Kendall et. al. (2002) investigated the relationship between personality traits and fibromyalgics, a disorder with symptoms of aching muscles, sleep disorders, and fatigue, associated with abnormal levels of the brain chemicals that transmit nerve signals (neurotransmitters) and electromyographic hyperactivity. Perceived muscle tension was found to correlate with aspects of anxiety proneness of the Karolinksa Scales of Personality (KSP). Hence, compared to healthy controls, rheumatoids and fibromyalgics scored significantly higher on the scales for muscular tension, somatic anxiety, and psychastenia. The KSP may be applicable if the reason for termination during exercise was pain. Due to the demographic sample of this research, which included mostly young college students, and the high inhalation resistance condition that would hinder performance, pain would probably be replaced with discomfort or the inability to breathe and be the primary reason for volitional termination of exercise. For studies involving older individuals, this may be very applicable.

2.12 CO_2 Sensitivity Testing

McNally and Eke (1996) used a carbon dioxide challenge (breathing deeply and rapidly into a paper bag for five minutes) to evaluate 78-college students CO_2 sensitivity. Multiple regression analyses revealed that Suffocation Fear Scale (SFS) was the only significant predictor of anxiety and bodily sensations relating to CO_2 sensitivity. He found that breath-holding duration did not predict response to CO_2 challenge. Because with the higher resistance, CO_2 buildup may be come a significant factor, future studies should incorporate SFS.

Chapter 3: Objectives

The four major goals of this research were to:

1. Test for correlation between personality or psychological predominance using the Myers-Briggs Type Indicator (MBTI) and performance time of each of the respiratory resistances;
2. Provide further evidence to support the relationship of performance time and sensitivity to resistance;
3. Analyze the predictive aspect of the State-Trait Anxiety Inventory (STAI) with respect to performance time at each corresponding resistance and the slope of performance time vs. resistance; and
4. Determine if VO_{2max} was a means to correlate performance time while wearing a respirator and the slope of performance time vs. resistance.

Chapter 4: Methods

The overall procedure consisted of four stages: orientation (MBTI), VO_{2max} pre-testing, 80-85% VO_{2max} testing, and CO2 sensitivity testing. The three inhalation resistance testing conditions were within 80-85% VO_{2max}. A total of 31 subjects completed all the resistance conditions.

4.1 Procedures

4.1.1 Orientation

An investigator met with the prospective participant to explain test procedures and methods utilized in the study. The participant was provided a written copy of the informed consent document, which further detailed this information. Each participant was asked to read and sign the informed consent document before being allowed to take part in the investigation. A brief medical history form was administered to participants and was used to provide investigators with information on the participant's present and past health status. Additionally, the subjects were given the Keirsey Temperament Sorter II, which is attached in Appendix 23 (very similar yet less expensive than MBTI, each question and calculation of personality trait is altered to not infringe on MBTI copyright). Other physical attributes such as height, weight, age, sex, and overall physical condition were noted. The participant was asked to complete a Physical Activity Readiness Questionnaire, which was used to determine whether vigorous activity was appropriate for the individual at that particular time.

4.1.2 VO_{2max} Pre-testing

A maximal oxygen consumption test was performed on all prospective participants using a motorized treadmill (Quinton Instrument Co. Seattle, WA). Participants were asked to warm-up and stretch for approximately 5-10 minutes prior to the start of the test. Participants were equipped with a one-way breathing valve (Hans Rudolph Inc., Kansas City, MO) configured with a rubber adaptable mouthpiece. This apparatus was interfaced with a standard Fleisch pneumotach (Phipps & Bird, Richmond, VA) and mass spectrometer (Perkin-Elmer, Pomona, CA) to monitor continuous expired airflow. Heart rate measurements were assessed using a standard ECG electrode configuration with the leads connected to a Patient Monitoring System (Hewlett Packard, Andover, MA).

In order to determine VO_{2max}, the initial work rate was established at a speed and grade designed to elicit 70% of the participant's age-predicted maximal heart rate. The work rate was adjusted every third minute until the participant experienced volitional fatigue, failed to display a rise in oxygen consumption (≥150 ml O_2) in accordance with the increase in work rate, or exhibited cardiovascular responses that contraindicated further assessment. This test was completed in approximately 9-15 minutes.

4.1.3 80-85% VO_{2max} Testing

Four sessions were conducted at 80-85% of the participant's maximal aerobic capacity using the Quinton motorized treadmill. One session utilized the Hans Rudolph one-way breathing valve configured with a rubber adaptable mouthpiece attached to a Fleish pneumotach. In the other three sessions, the participant donned a U.S. Army M40 full-face respirator mask with inhalation modified with an orifice insert to give resistances of 2.78, 16.79, or 27.27 cmH_2O*(sec/L) at a measured flow rate of 85 L/min. The exhalation port was not modified and contained a standard valve resistance of 1.34 cmH_2O*(sec/L) at a measured flow rate of 85 L/min.

Before the first resistance condition, the subject was required to take the State/Trait Anxiety Inventory (STAI). Then the participant was asked to warm-up and stretch for approximately 5-10 minutes prior to the start of the session. A respirator was affixed to the participant, and the treadmill speed and grade were set at a work rate eliciting approximately 70% of the individual's age-predicted maximal heart rate. This work rate was increased every two minutes until the speed and grade corresponding to 80-85% VO_{2max} was reached. The participant was asked to exercise at this intensity until he or she experienced volitional fatigue. All subjects were monitored for Heart Rate (HR) every one minute, minute volume (V_E) every 30 seconds, and VO_2 every 30 seconds during all conditions. These procedures were used in all conditions (minimum resistance, middle resistance, and maximum resistance). Rating of Perceived Exertion and Breathing Apparatus Comfort Scales were taken every two minutes to objectively gauge fatigue and comfort of the subject during each condition. Each session took a total of one hour, including the 5-20 minutes of exercise.

4.2 Grouping of MBTI Variables

The tendencies of each group (SN,TF, JP, and EI) were represented by a fraction in order to reduce the number of predictor variables within the MBTI parameters and look at each of the four preferences as continuums of extraversion-introversion (EI), sensing-intuition (SN), thinking-feeling (TF), and judging-perceiving (JP) rather than eight different personality traits, E, I, S, N, T, F, J, and P. Reducing of the variables was warranted because a test of correlation between E and I, S and N, T and F, and J and P showed a high inverse relationship (i.e. the extroversive tendency meant less introversive tendency because each dominant personality trait was determined by summing both scores and picking the personality that had the higher score). The following equations show the calculations for each grouped variable:

EI = # of Extraversion positives ÷ Total # of questions for Extraversion-Introversion
SN = # of Sensing positives ÷ Total # of questions of Sensing-Intuition.
TF = # of Thinking positives ÷ Total # of questions for Thinking-Feeling.
JP = # of Judging positives ÷ Total # of questions for Judging-Perceiving.

Each of the preference group variables (EI, JP, TF, and SN) was used as a predictor for the resulting response variable such as slope or performance time at each resistance condition. With the exception of Extraversion-Introversion having ten questions, all other grouped variables had 20 questions.

4.3 Method of Statistical Analysis

A multiple regression and an ANOVA test were used to determine if one of the predictive variables was related to the response. A stepwise procedure, specifically the step-down or backward elimination procedure that began with all of the predictor variables and eliminated the least predictive one by one, until the point where the elimination of another would sacrifice a significant amount of explained variance in the criterion variable was used (Kachigan, 1986). The least predictive variables were determined by the greatest p-value ($p > 0.05$). The predictive variables initially analyzed together and then eliminated one by one were SN, TF, JP, EI, MinVolume R1, MinVolume R2, MinVolume R3, VO_{2max}, age, Max Heart Rate, Trait-Anxiety Score, STAI pre and post difference, height, and weight. The criterion variables: R1 time, R2 time, R3 time, and Resistance Sensitivity, respectively, were individually analyzed with all the predictive variables. The following data were analyzed using MINITAB Inc. Software version 14 (State College, Pennsylvania).

The accuracy of prediction depended on the extent of correlation between the variables in question (Kachigan, 1986). Each predictor variable is associated with its own beta weight. The beta weights are a function of the correlations of the individual predictor variables with the criterion variable, and the correlations that exist among the predictor variables themselves. The R^2 value signifies the proportion of variance in the criterion variable predictable from variation in the derived variables. An adjusted R^2 is similar to an R^2 except $R^2_{adjusted} = R^2 * (k-1)/(n-1)$ where k is the number of predictor variables and n is the sample size to reflect the actual number of variables and objects studied. Reliability of each variable in question was not tested for reproducibility because of impracticality of reproducing the experiment and the cost associated with that endeavor. Unusual observations automatically identified by MINITAB and were outside 2.90 standard deviations were considered outliers and removed. According to the empirical rule for distributions that are generally bellshaped or normal, about 99% of all data items lie within about three standard deviations of the mean (Sanders and Smidt, 2000).

Chapter 5: Results

5.1 Summary of Statistics

Demographics of the subjects who participated in the study are listed in Table 1. Most of the subjects were students from the University of Maryland at College Park. To control physiological variances due to circadian rhythms, most of the subjects were asked to test the same time each day.

Table 1. Demographics of 31 subjects tested. Sex, Height, Weight, Maximum Heart Rate (MaxHR), Trait-Anxiety (Trait), and Maximum Oxygen Consumption (VO_{2max}) are statistically described.

	Sex (F=0,M=1)	Height (cm)	Weight(kg)	MaxHR (beats/min)	Age (Years)	Trait Anxiety	VO_{2max} (L/min)
Avg	48% male	171.12	65.53	192.23	24.74	31.84	2.49
Stdev		9.22	12.80	11.09	5.32	6.90	0.71
Var		85.05	163.84	123.01	28.33	47.61	0.50
Max		185.42	107.00	211.00	39.00	52.00	4.47
Min		152.40	45.50	168.00	19.00	20.00	1.25

When each of the predictive variables was compared to each criterion variable and was eliminated one by one according to the greatest p-value, the following analysis had a p-value greater then 0.05: Table 2 summarizes the resulting simple regression found to be statistically significant. The only multiple regression that was found to be statistically significant was sensing-intuition (SN) with thinking-feeling (TF) vs. R3 performance time. Affects of gender were not analyzed.

Table 2. The following Table of P-values are the results of a simple Analysis of Variance between two variables. P-values less then 0.05 were considered significant and are shaded. The following are the variables: Extraversion-introversion (EI), Sensing-Intuition (SN), Thinking-Feeling (TF) and Judging-Perceiving (JP), Trait Anxiety (Trait), Maximum Oxygen Consumption (VO_{2max}), Resistance Sensitivity, and performance times while wearing low, medium, and high inhalation resistances (R1,R2, R3 times). Circular Reasoning (CR) is comparisons to its self and should be ignored. A total of 31 subjects were tested.

n=31	**P-values < 0.05 are significant and shaded.**					
NA=Not Applicable	**EI**	**SN**	**TF**	**JP**	**Trait**	**VO_{2max}**
R1 time	0.968	0.73	0.373	0.99	0.027	0.044
R2 time	0.805	0.901	0.117	0.7	0.27	0.015
R3 time	0.972	0.162	0.275	0.93	0.433	0.059
Resistance Sensitivity	0.929	0.605	0.561	0.95	0.945	0.116
Height	0.264	0.554	0.396	0.52	0.291	0
Age	0.988	0.269	0.396	0.09	0.382	0.099
Max HR	0.562	0.873	0.833	0.74	0.069	0.4
Weight	0.003	0.958	0.862	0.38	0.194	0
VO_{2max}	0.135	0.754	0.913	0.53	0.141	CR
Trait	0.46	0.788	0.572	0.54	CR	0.141
JP	0.9	0	0.001	CR	0.54	0.53
TF	0.558	0.032	CR	0.001	0.572	0.913
SN	0.67	CR	0.032	0	0.788	0.754
EI	CR	0.67	0.558	0.9	0.46	0.135

5.2 <u>R3 Performance Time vs. SN and TF</u>

The primary purpose of this thesis was to test for correlation between MBTI predominance and performance time of each of the R1, R2, and R3 conditions. R1 and R2 performance times showed no correlation with MBTI. However, the R3 resistance condition showed significant correlation to the SN and TF criteria of MBTI. A Step-down procedure was used to eliminate EI and JP. When an individual was stressed with a high R3 inhalation resistance, psychological predominance of SN and TF became key variables to predicting R3 performance time. Perhaps sufficient stress of inhalation breathing was required for psychological predominance to become a factor.

The resulting multiple regression equation 2 correlates SN and TF with R3 performance time. One observation was outside the 2.9 standard deviations and was considered an outlier. Detailed MINITAB outputs can be found in Appendix 1.

$$\text{R3 performance time (sec)} = 133 - 117\ \text{SN} + 121\ \text{TF} \qquad (2)$$

Both R^2 = 21.0% and $R^2_{adjusted}$ = 15.2% were low and showed insignificance. However, based on the presence of a p-value of 0.041, there was evidence that R3 performance times are affected by the SN and TF variables. As depicted by Figures 3 and 4, there is evidence that SN and TF contribute to the criterion variable R3 performance time. Performance times of less than 50 seconds for both the contour and surface plots were regions of data holes or voids. Further testing of different combinations of SN and TF within the voided regions needs to be accomplished by increasing the sample size and testing more subjects within the data holes. Figure 5 illustrates the resulting best-fit plane that corresponds to the 3D plots. The plane depicts that individuals with the highest SN score and lowest TF score would run the longest in the R3 condition.

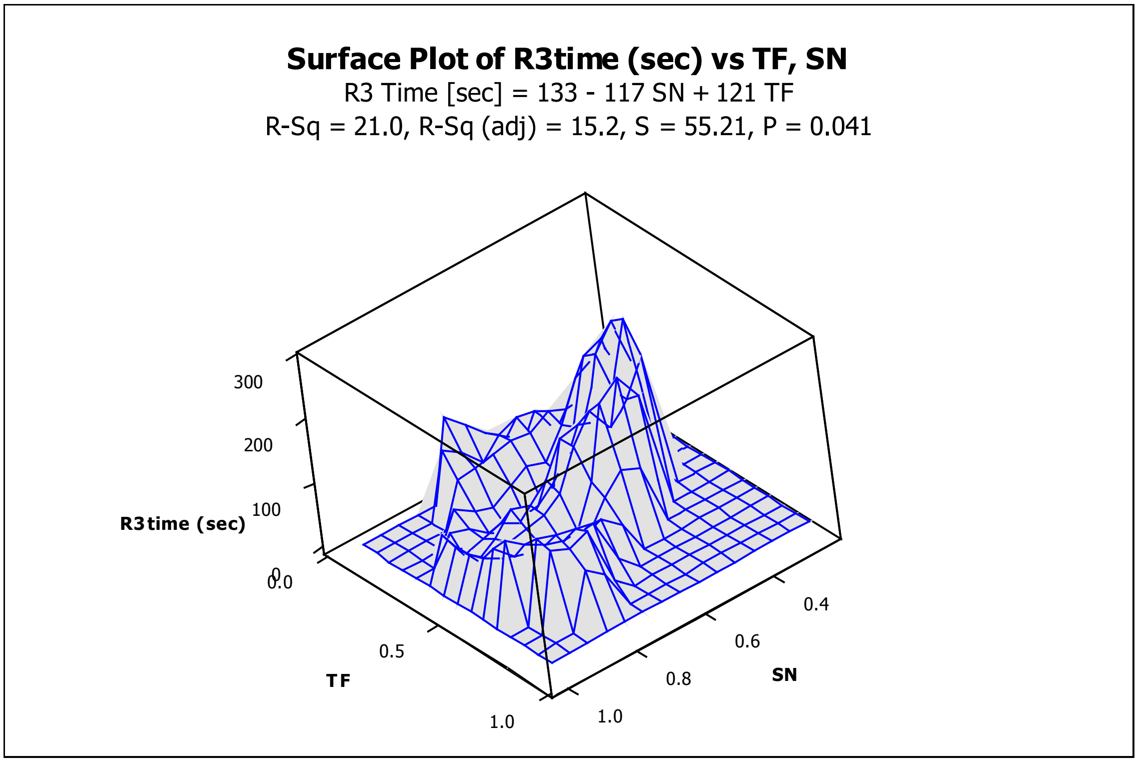


Figure 3. Surface Plot of R3 Performance Time vs. Thinking-Feeling (TF) and Sensing- Intuition (SN). The surface plot depicts that SN and TF contribute to the criterion variable R3 performance time. Performance times of less than 50 seconds or flat regions are data holes or voids resulting from no subjects with TF and SN scores. The resulting equation is a best-fit plane of the surface plot.

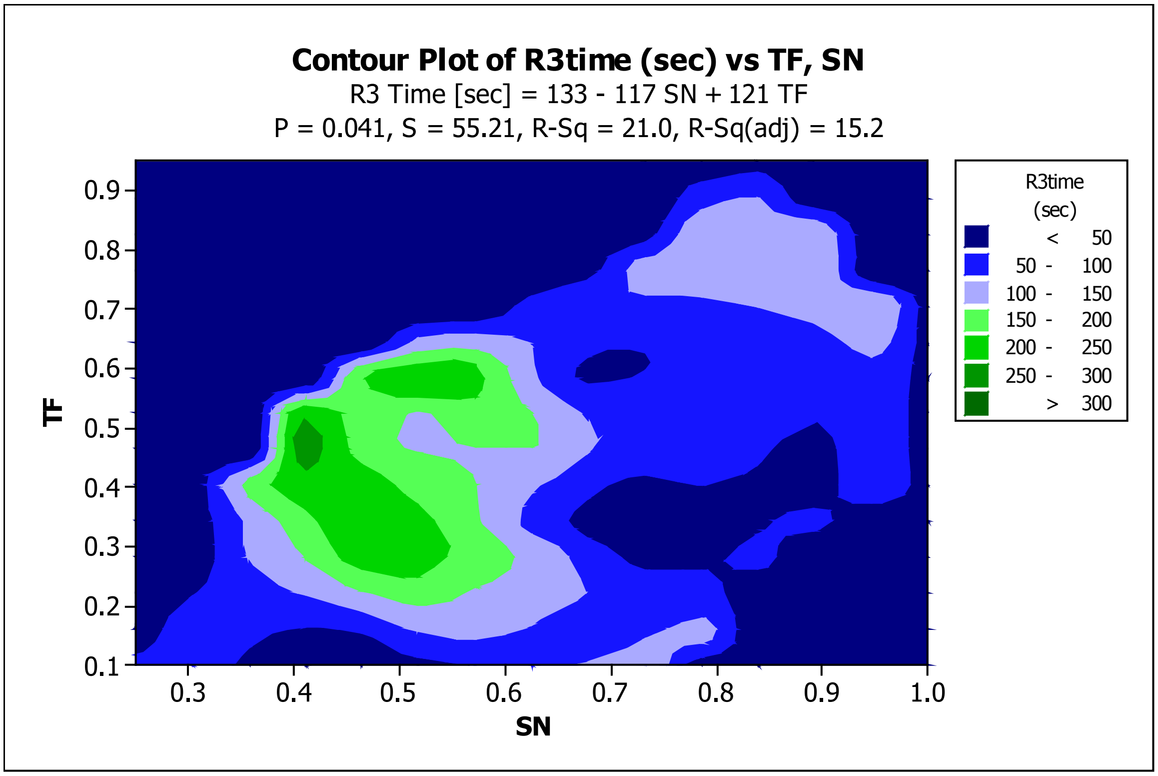


Figure 4. Contour Plot of R3 performance time vs. SN and TF. The contour plot depicts different combinations of TF and SN that contribute to the R3 performance time. Performance times of less than 50 seconds or flat regions are data holes or voids resulting from no subjects with TF and SN scores. The resulting equation is a best-fit plane of the surface plot.

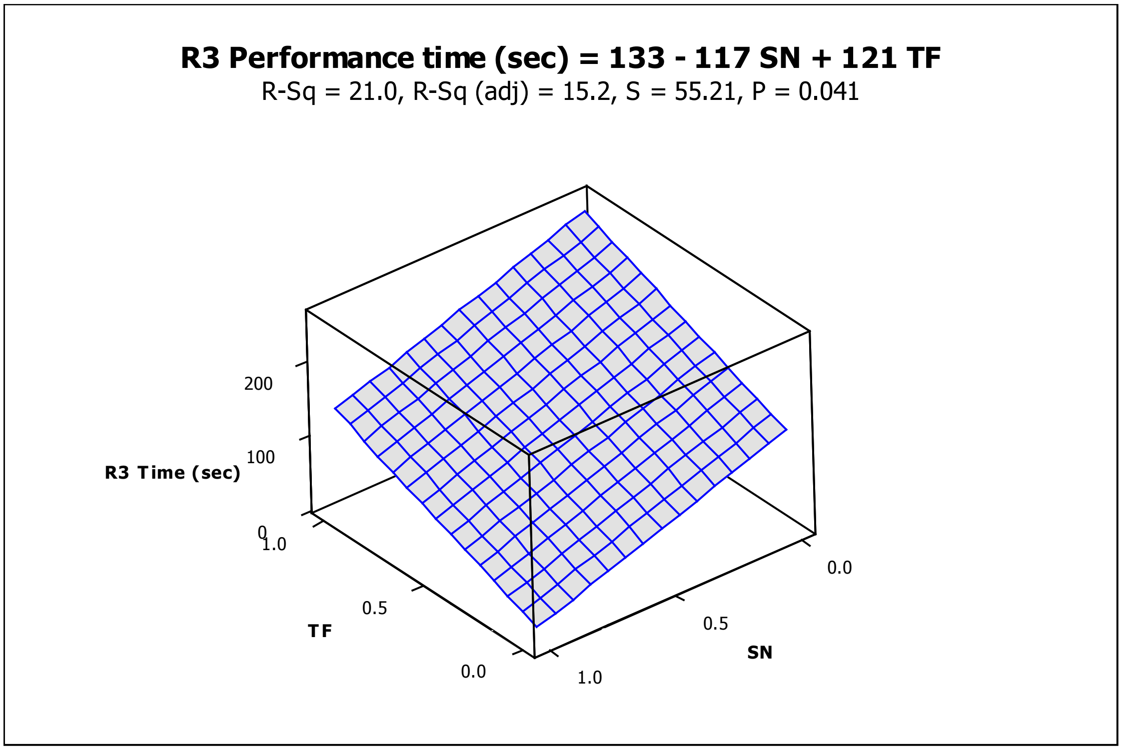


Figure 5. The best fit plane of R3 performance time vs. TF and SN is the resulting multiple regression function that best fits the surface plot. This plane indicates that individuals with highest TF score and lowest SN score would have the greatest R3 performance time.

5.3 Minimum Resistance Performance Time and Resistance Sensitivity

One of the primary objectives of this thesis was to provide further evidence to support the relationship of performance time and sensitivity to resistance. Resistance sensitivity was derived by plotting each of the individual performance times with resistance. A plot of three points and a best-fit line generated a function with a distinct slope and y-intercept. The slope was the individual resistance sensitivity. For example, for subject #145, the resulting plot in Figure 6 shows a function with a slope of –13.622. This –13.622 would be the subject's resistance sensitivity. The $R^2 = 0.963$ may be a good fit because there is only inhalation resistance conditions. More resistance values needs to be tested.

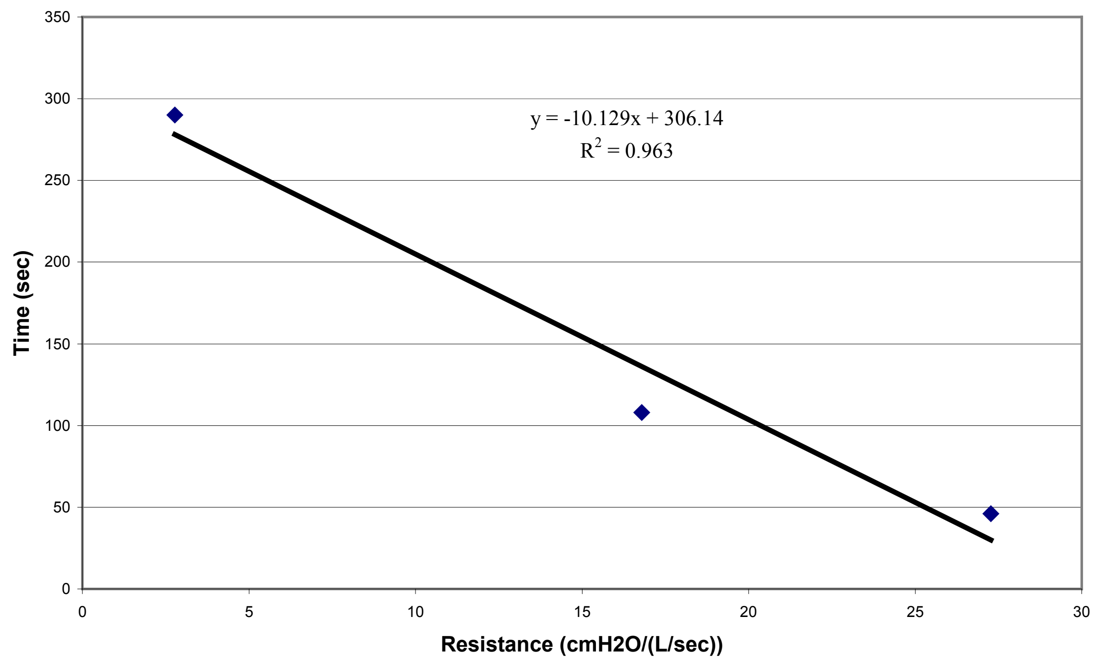


Figure 6. Subject #145 performance time vs. resistance.

Individuals who ran the longest at the low inhalation resistance were most sensitive to resistance. The resulting regression line showed:

R1 time (sec) = 152 - 18.2 * Resistance Sensitivity [sec/(cmH_2O/(L/sec))] (3)

Both $R^2 = 96.1\%$ and $R^2_{adjusted} = 96\%$ showed statistical significance by an ANOVA test. This means that individuals who ran the longest R1 were more resistance sensitive. Figure 7 illustrates that individuals who ran longer with the R1 condition had higher resistance sensitivity. This analysis confirms that resistance sensitivity contributes to the R1 performance time criterion variable. Further detail is in Appendix 2.

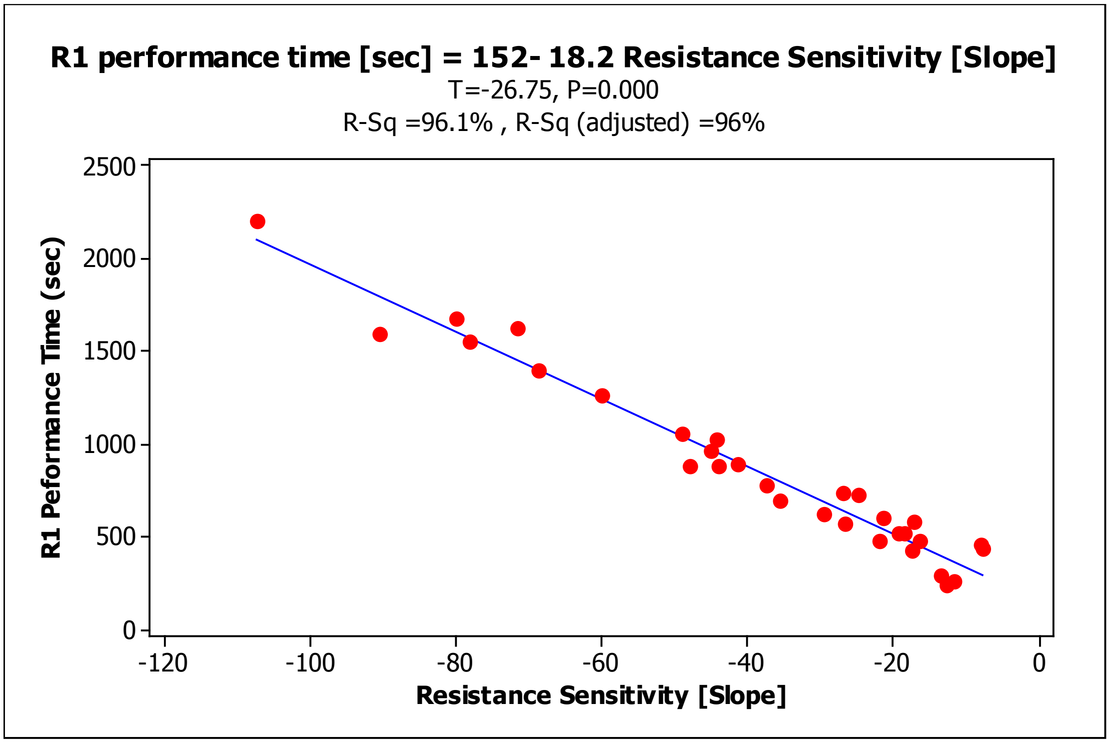


Figure 7. R1 time vs. Resistance Sensitivity [slope]. R1 inhalation resistance performance time of all subjects shows a linear relationship to sensitivity of resistance defined as the slope of performance time vs. inhalation resistance. Standard deviation (S) was 97.8159.

5.4 Resistance Sensitivity vs. Trait Anxiety Score

If resistance sensitivity is a measure of an individual's adversity to high inhalation resistance, then there should be some significant correlation between trait anxiety score and resistance sensitivity (slope of performance time vs. resistance). The following regression line affirmed that there was a direct relationship between resistance sensitivity vs. anxiety score. Trait Anxiety scores can range from 20-68.

$$\text{Resistance sensitivity } [\text{sec}/(\text{cmH}_2\text{O}/(\text{L/sec}))] = 12.6 - 1.60 * \text{Trait Anxiety} \quad (4)$$

Both R^2 = 17.8% and $R^2_{adjusted}$ = 14.9% were low. A low R^2 is expected because of the cross population comparison. However, based on the ANOVA having a p-value of .018 < 0.05, there was significant evidence that resistance sensitivity related to anxiety score. Figure 8 illustrates that even though there is a lot of scatter, individuals with high anxiety scores had high resistance sensitivities. This analysis confirms that anxiety levels contributed to the resistance sensitivity criterion variable. Further details of the MINITAB output can be found in Appendix 3.

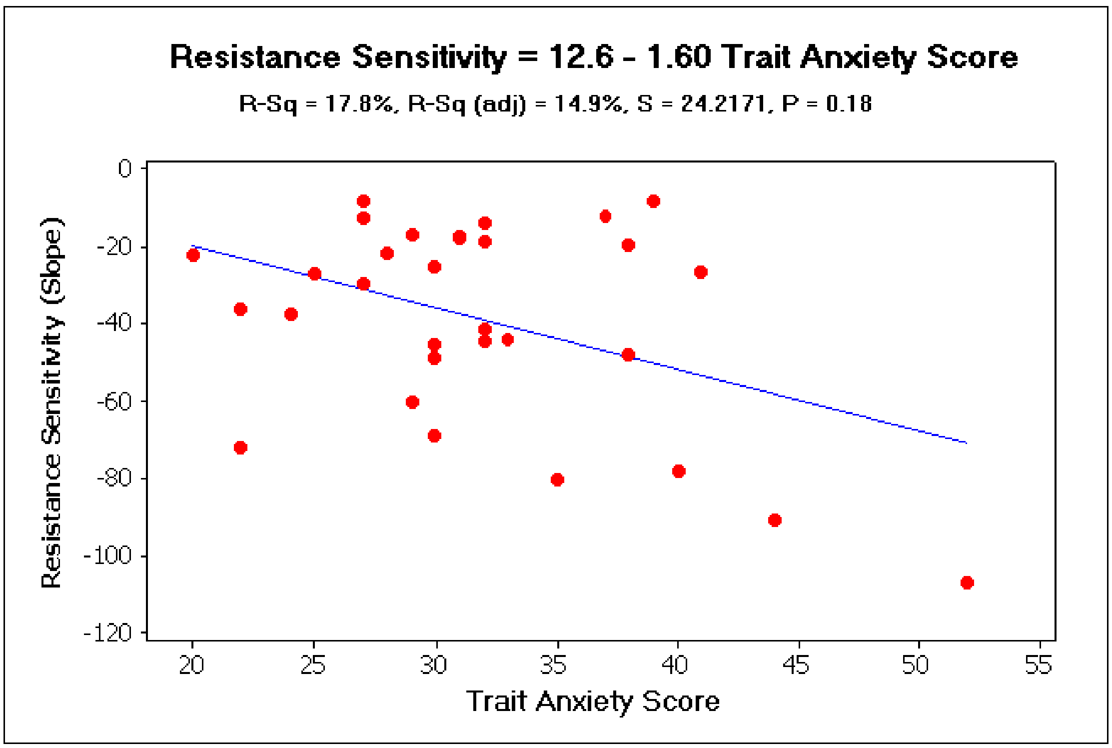


Figure 8. Resistance sensitivity vs. trait anxiety score. Anxious individuals have higher resistance sensitivity. Although scattered, the p-value < 0.05 shows significant evidence that resistance sensitivity is related to anxiety score.

5.4.1 Performance time vs. Trait Anxiety Score

Previous studies by Johnson et. al. (1995) showed that individuals with high anxiety scores performed for shorter times while wearing a respirator. Based on the results of this thesis, the negative affects of trait anxiety score with respect to performance time only became a factor in the R3 condition. Further testing is necessary to isolate the high threshold inhalation resistance at which anxiety score becomes a negative factor with respect to performance time.

Because the p-value was 0.116 > 0.05, from Figure 9 the slight tendency for the anxious individual to perform for a shorter time with respect to the R3 performance time may be misleading. Further testing is required to substantiate that anxious people perform for a shorter time. One observation was outside the 2.9 standard deviations and was considered an outlier. Further details of MINITAB output can be found in Appendix 4. Trait Anxiety scores can range from 20-68.

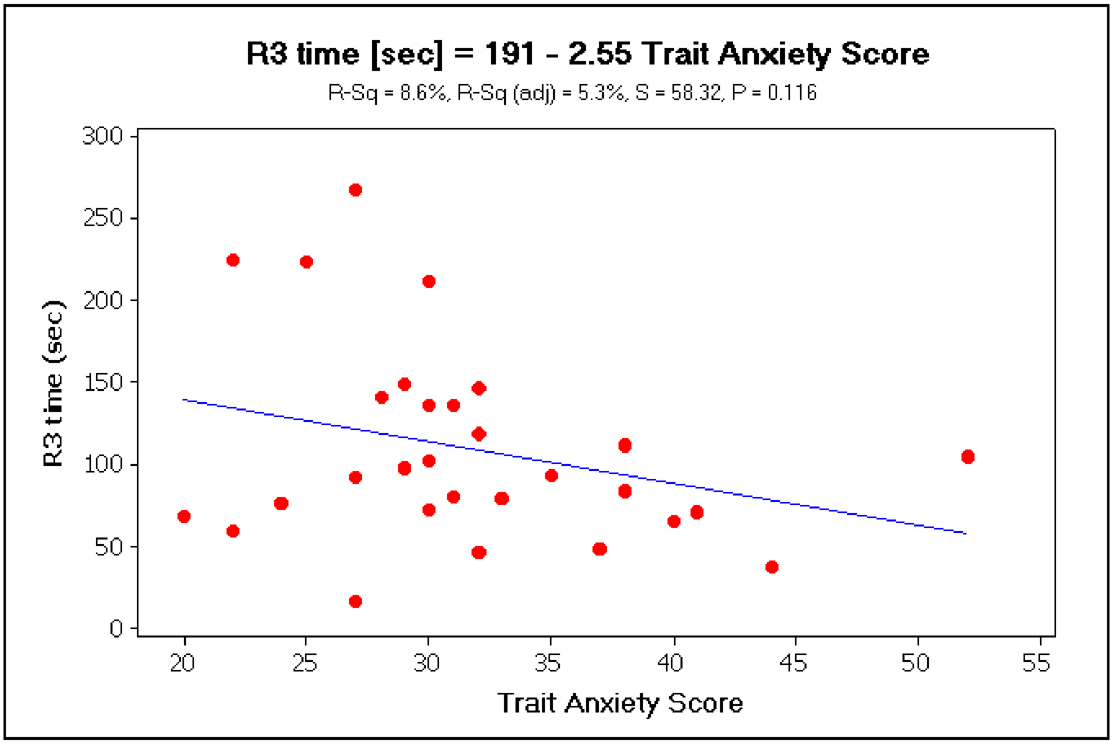


Figure 9. R3 Performance time vs. Trait Anxiety score. Because the p-value was greater then 0.05 the best-fit equation may be misleading.

Individuals with higher anxiety scores ran for longer durations during the R1 condition (Figure 10). Both $R^2 = 15.7\%$ and $R^2_{adjusted} = 12.8\%$ were low. Based on the ANOVA having a p-value of $0.027 < 0.05$, there was significant evidence that R1 performance time related to anxiety score. However, the resulting regression line was contrary to the Johnson et. al. (1995) study where they found that high anxiety scores adversely affected performance time while wearing a respirator. Further testing is necessary to substantiate that inhalation resistance was not high enough to cause an anxious characteristics to become a negative factor in R1 performance time. More details can be found in Appendix 5. MINITAB did identify the individual with a 52 trait anxiety as a large influence in the best-fit line. Trait anxiety score was assumed to remain constant for each of the subjects and was plotted against each individual respective R1, R2, and R3 performance time for simple regression analysis. Further details are included in Appendix 6.

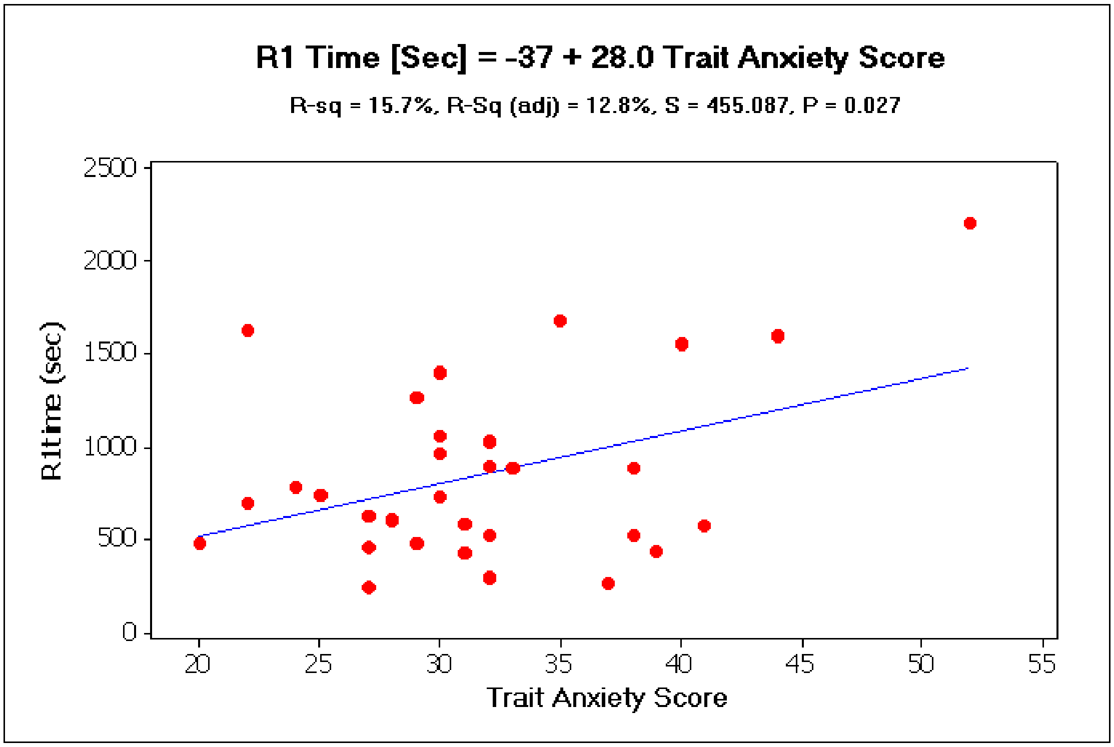


Figure 10. R1 performance time vs. Trait Anxiety score. Minitab identified an individual with 52 anxiety to have a large influence in the best fit-line. Further testing is necessary to substantiate that inhalation resistance was not high enough to cause the anxious characteristic to become a negative factor in R1 performance time.

5.5 Analysis of Performance Time vs. Max Oxygen Consumption

Burke and Jin (1996) found significant inverse correlation with shorter performance time of triathlons (no respirator condition) and high VO_{2max} values. Because most individuals who ran the fastest race or finished earlier had high VO_{2max}, that individual would run harder and demand more oxygen. Hence, the individual with high VO_{2max} would be more adversely affected by the inhalation resistance then individuals with low VO_{2max}. For both R1 and R2 performance times, subjects with high VO_{2max} performed for a shorter duration than individuals with low VO_{2max}. The respective plots of R1 and R2 performance times vs. VO_{2max} were p=0.04, 0.015 are illustrated in Figure 11 and Figure 12. Individuals with high VO_{2max} performed for shorter durations. Details of the MINITAB output are attached in Appendix 7. With the high resistance R3, performance time was insignificantly correlated to VO_{2max}. Further studies need to be performed to illustrate the possibility that physiological reasons for termination changes to psychological reasons for termination at some specific inhalation resistance.

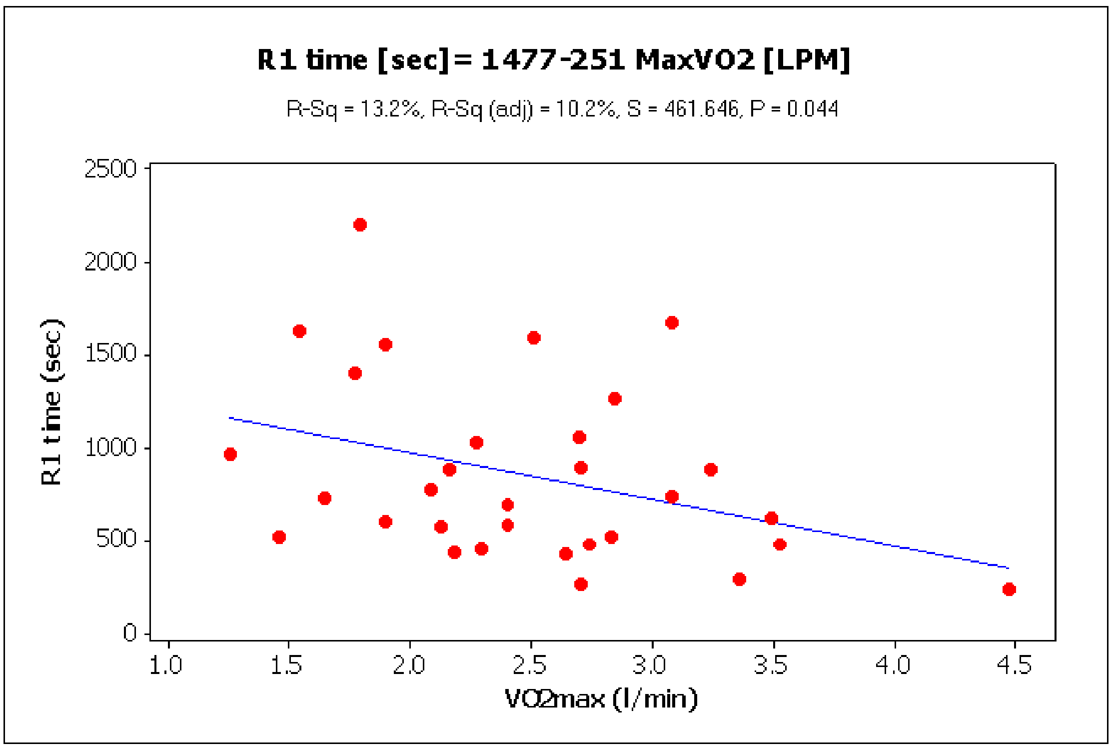


Figure 11. Performance time vs. VO_{2max} for the R1 condition.

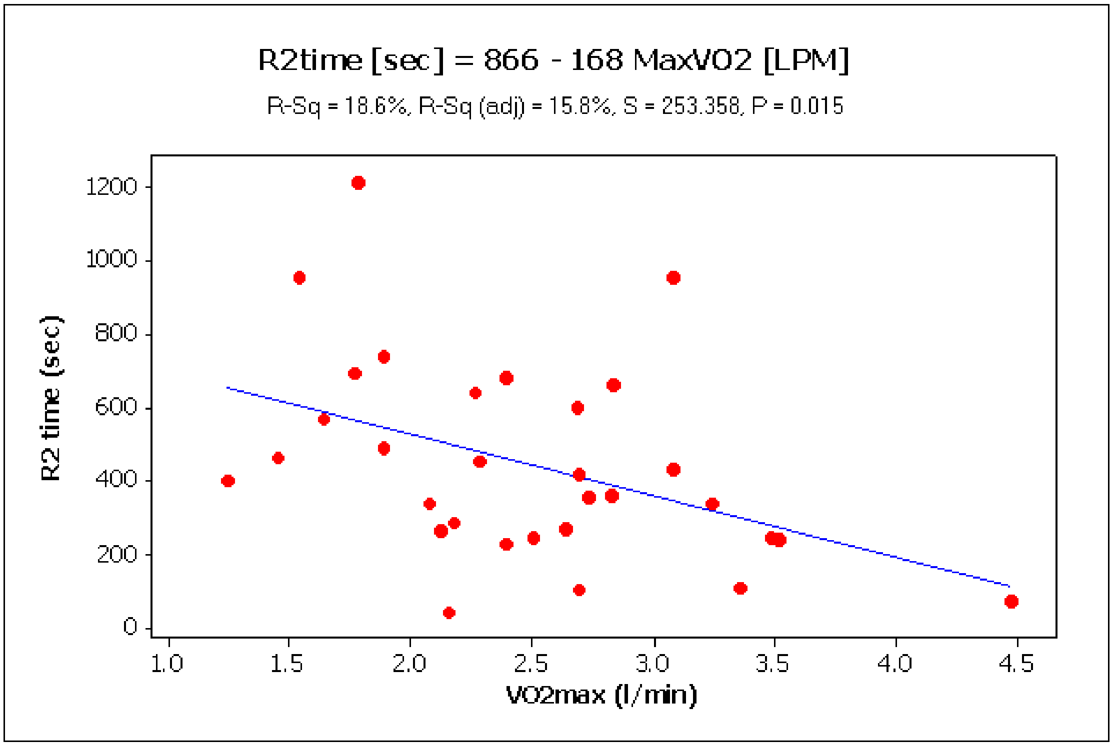


Figure 12. Performance time vs. VO_{2max} for the R2 condition.

5.6 Analysis of R3 performance time vs. Sensing, Feeling, and Trait Anxiety

Individuals who gather information using their senses (SN is high) and make a decision on their gut feeling (TF is Low) consistently terminate testing sooner. R1 and R2 performance times had non-significant correlation to MBTI. Psychological factors became more predominant with the R3 condition; the anxiety score tended to reduce R3 performance time. Perhaps sensing, feeling and trait anxiety somehow combined to become independent variables at predicting R3 performance time. Sensing and feeling scores can range from 0 to 10. The following function correlates the R3 performance time with anxiety, sensing, and feeling:

$$\text{R3 time (sec)} = 345 - 5.69\ \text{Sensing} - 6.63\ \text{Feeling} - 2.78\ \text{Trait Anxiety} \qquad (6)$$

Both R^2 = 33.8% and $R^2_{adjusted}$ = 26.2% were low, but based on the p-value of 0.012 < 0.05, there was significant evidence that R3 performance time may be related to sensing, feeling, and anxiety. As illustrated by equation 6, sensing, feeling, and anxiety reduced R3 performance time. Further details of this output are included in Appendix 8.

5.7 Psychological Factors vs. Max Oxygen Consumption

When comparing the physiological factor (VO_{2max}) with psychological factors (anxiety, EI, SN,TF, JP) the question of which was the independent variable could be dismissed if there was no relationship found. None of the psychological factors related to the VO_{2max} ($p > .05$). Each of the step-down approaches is depicted in Appendix 9. Because VO_{2max} and psychological factors are independent, personality may be essential in models that predict human performance time while wearing a respirator.

Chapter 6: Discussion

Performance time while wearing a respirator with minimum resistance correlated highly (R^2 >.90) with resistance sensitivity. In order to better understand why individuals who performed longer in the minimal resistance condition would be most affected by higher resistance, the results of this thesis showed that there was no single definitive variable that could assist in predicting an individual's performance time while wearing a respirator under R1, R2, or R3 resistance conditions. Additionally, different predictor variables became more of a factor with different inhalation resistances. Within the scope of this thesis, different predictor variables contributed to performance time for each of the R1, R2, and R3 conditions. Subjects with high VO_{2max} usually had high minute volume and were more prone to performance decrement caused by inhalation resistance (Appendices 14 & 15). Hence, individuals with high VO_{2max} who produced high minute volumes were more affected by resistance and performed for shorter durations for both R1 and R2 conditions (Appendices 7, 11, 12, & 13). Psychological parameters of MBTI (sensing-intuition and thinking-feeling) and Trait Anxiety only came into play for the highest resistance R3 condition when inhalation flow resistance was very high. Anxious people also had higher resistance sensitivity (slope). Physiological parameters considered within this study had no relationship to R3 performance time. MBTI personality traits and Trait Anxiety can assist in predicting performance time only in the R3 condition.

Certain conclusions were drawn from the analyzed data. Psychological factors measured by MBTI came into play when there was adequate inhalation resistance to cause distress. Specifically, when R3 resistance constricted air intake, sensing- intuition (how one takes in information) and thinking-feeling (how one makes a decision) became components that reduced performance time. Threshold inhalation resistance that may have caused an individual to switch from physical contingency to psychological contingency may have fallen between the R2 and R3 resistances.

The threshold inhalation that may have caused an individual to switch from physical contingency to psychological contingency may exist between R2 and R3 resistance. However, further study is necessary to determine if physical contingency to psychological is a distinct switch resistance point. More experiments of performance time with further resolution of resistance between R2 to R3 may be one way to determine the existence of a threshold resistance.

Because many of the subjects who ran the R3 condition complained of headaches and other symptoms of CO_2 build up, perhaps blood oxygen concentration should be evaluated. Perhaps blood oxygen concentration and personality trait are variables in the outcome of performance duration while wearing a resistance between R2 and R3. As mentioned by McNally and Eke (1996), Suffocation Fear Scale (SFS) could also be a factor in contributing to resistance sensitivity and should be included in future studies.

Resistance sensitivity (the slope derived from the performance time vs. resistance) showed significance ($p=0.018 < 0.05$) with only trait anxiety scores. When resistance sensitivity was plotted vs. trait anxiety scores, individuals with higher anxiety consistently had higher sensitivity to resistance. This reaffirmed

Johnson et. al.'s (1995) study that individuals with high trait anxiety score performed for a shorter duration and were more sensitive to inhalation resistance. However, the negative affect of trait anxiety score on performance time only became apparent in the R3 condition. This further illustrates that sufficient inhalation resistance is needed to cause trait anxiety to become a factor in the R3 performance.

Lindstedt et. al. (1994) showed that people with high VO_{2max} had high inspiratory flow. Since minute volume is a measure of average flow rates within a given time, it could be determined that people with high VO_{2max} had high minute volume. This relationship was observed by this study because there was a relationship between VO_{2max} and minute volume in the R1 and R2 conditions corresponding to their respectively high VO_2 values. The results from Figure 11 and Figure 12 also reaffirm that individuals with high VO_{2max} were more affected by inhalation resistance and performed for a shorter duration for both R1 and R2 conditions.

In summary, the following variables were found to correlate to an individual's R1 and R2 performance times while wearing a respirator: minute volume and VO_{2max}. Sensing-intuition (SN), thinking-feeling (TF) and anxiety combined to contribute to R3 performance time. This implied that there was a threshold inhalation resistance that an individual's psychological predisposition (MBTI and Trait Anxiety) factored into performance time. The interrelationship between psychological (MBTI + Trait Anxiety) and physiological (minute volume + VO_{2max}) showed no relationship.

Respirator inhalation resistance has a direct relationship to respiratory protection. For maximum respiratory protection, circumstances may arise when R3 equivalent resistance may be warranted. Hence, models that incorporate high resistance should include these effects. Individuals who may have high SN scores and low TF scores and high trait anxiety score will be most affected and perform for a shorter time. Performance time with the R3 condition ranged from 16 seconds to about 5.15 minutes. There may be emergency circumstances for which 5 minutes may mean the difference between life and death. If the inhalation resistance filters are greater than 16.79 cmH_2O (Sec/L), the SN, TF, and trait anxiety may become a realistic consideration for supervisors and users in determining the rotation time and selection process of who can enter a given emergency situation. However, most commercially available respirators and self-rescuers do not have R3 resistance and hence administration of MBTI and Trait Anxiety may not be necessary.

Chapter 7: Conclusions

Personality or psychological predominance MBTI only contributed to the R3 performance time. Individuals who gather information using their **senses** (SN is high) and make a decision on their gut **feeling** (TF is Low) consistently terminate testing sooner. R1 and R2 performance times had non-significant correlation to MBTI.

The results of this thesis reaffirmed that there was a high correlation between R1 performance time and sensitivity to resistance. There was a direct relationship between resistance sensitivity and Trait Anxiety. Significant evidence showed that individuals with high Trait Anxiety score also had high resistance sensitivity. With respect to Trait Anxiety and performance time, only the R3 condition showed evidence of performance time decrement while wearing a respirator. In other words, individuals with high anxiety had shorter R3 performance times.

VO_{2max} can be used as a predictor to correlate performance time while wearing a respirator with R1 or R2 inhalation resistances. The R3 condition showed no significance to VO_{2max}.

Anxiety, sensing-intuition and thinking-feeling can be used as predictors for R3 performance time. The combination of MBTI and STAI can assist in predicting an individual's performance time if the inhalation resistance is high enough to force psychological factors to contribute to the decision to terminate testing.

Chapter 8: Future Studies

Further investigation of other psychological tests that may relate to restrictive sensitivity should be conducted. From the MBTI test results, various voids of data with respect to personality types may have increased the chance of error. In order to compensate for the voids of data, more subjects need to be tested in order to further validate that the sensing and feeling parameters of MBTI do factor into R3 performance time. There was some evidence showing that there are negative affects of trait anxiety score on high resistance performance time, but further studies are necessary to definitively relate trait anxiety score to high resistance performance time. As mentioned in the literature searches, the Hogan Personality Inventory (HPI) and Herrmann Brain Dominance Instrument (HBDI) could assist in verifying the current MBTI results and increasing the parameters of personality traits that relate to airway restrictive sensitivity.

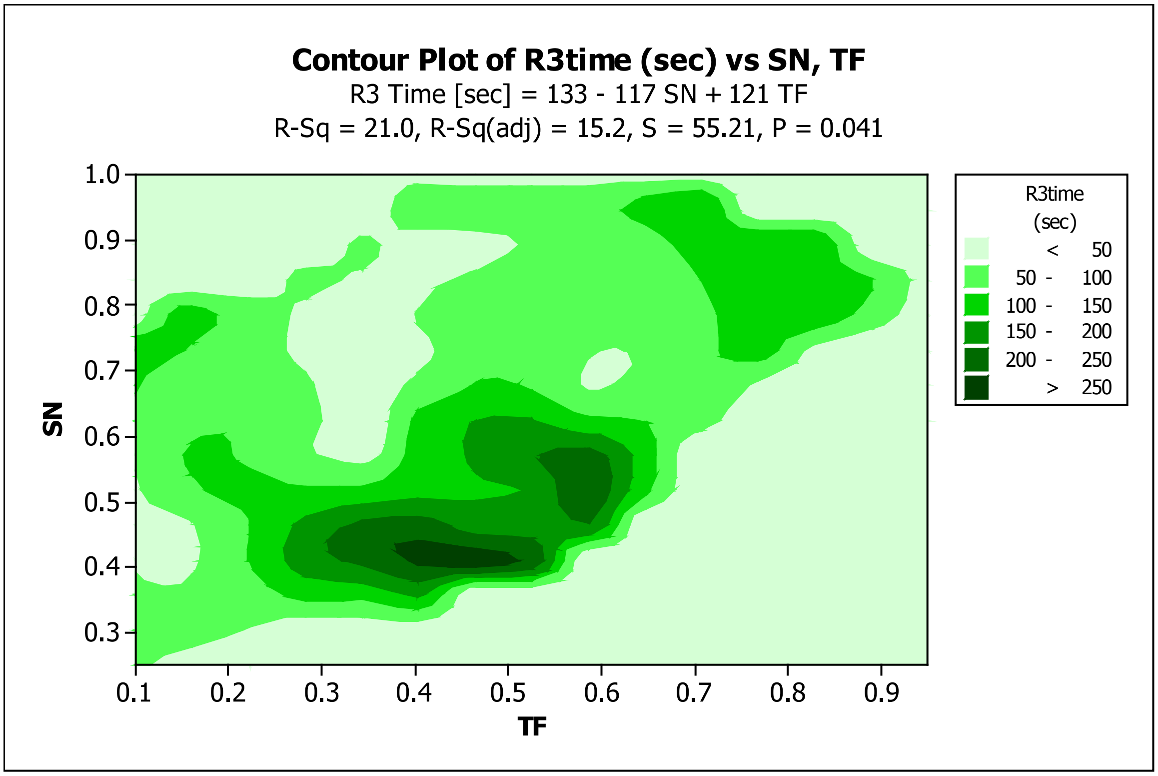
Physiological parameters such as maximum volume of air exhaled within one second (FEV_1), maximum voluntary ventilation within 15 seconds $MVV_{.25}$, respiratory resistance, and actual inhalation flow rate during the testing of the different resistance conditions could also provide additional information.

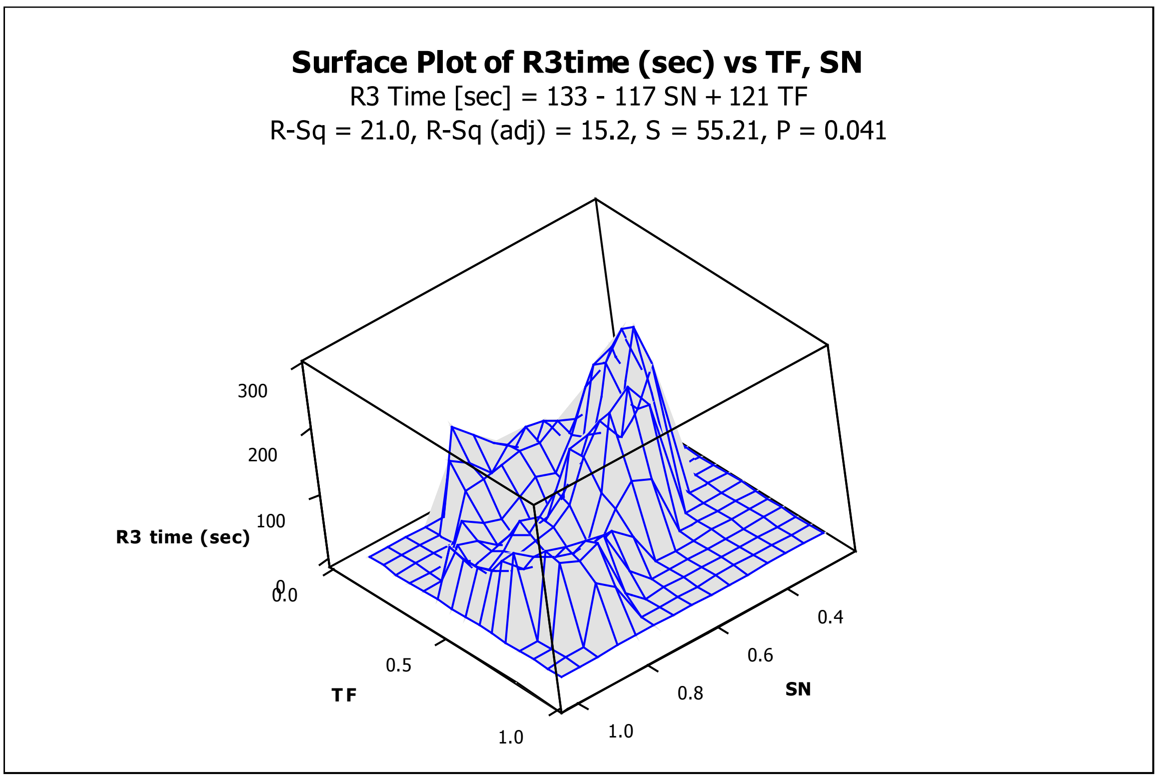
Reliability of the different variables in question for reproducibility could narrow the range of outliers and increase the accuracy. Expanding the number of subjects and incorporating more inhalation resistances between R1 to R3 could improve the accuracy of resistance sensitivity (slope of performance time vs. resistance conditions) and reduce error. Because individuals were not directed to eat the same food and limit prior physical exertion as to not affect the performance time, perhaps future studies should control for food intake and physical exertion pre testing.

Appendix 1 (R3 time vs. SN + TF)

Regression Analysis: R3time (sec) versus SN, TF

```
The regression equation is
R3time (sec) = 133 - 117 SN + 121 TF


Predictor      Coef  SE Coef      T      P
Constant     132.51    34.18   3.88  0.001
SN          -117.24    54.45  -2.15  0.040
TF           121.20    52.76   2.30  0.030


S = 55.2099   R-Sq = 21.0%   R-Sq(adj) = 15.2%


Analysis of Variance

Source          DF      SS     MS     F      P
Regression       2   21894  10947  3.59  0.041
Residual Error  27   82300   3048
Total           29  104193


Source  DF  Seq SS
SN       1    5805
TF       1   16088
```

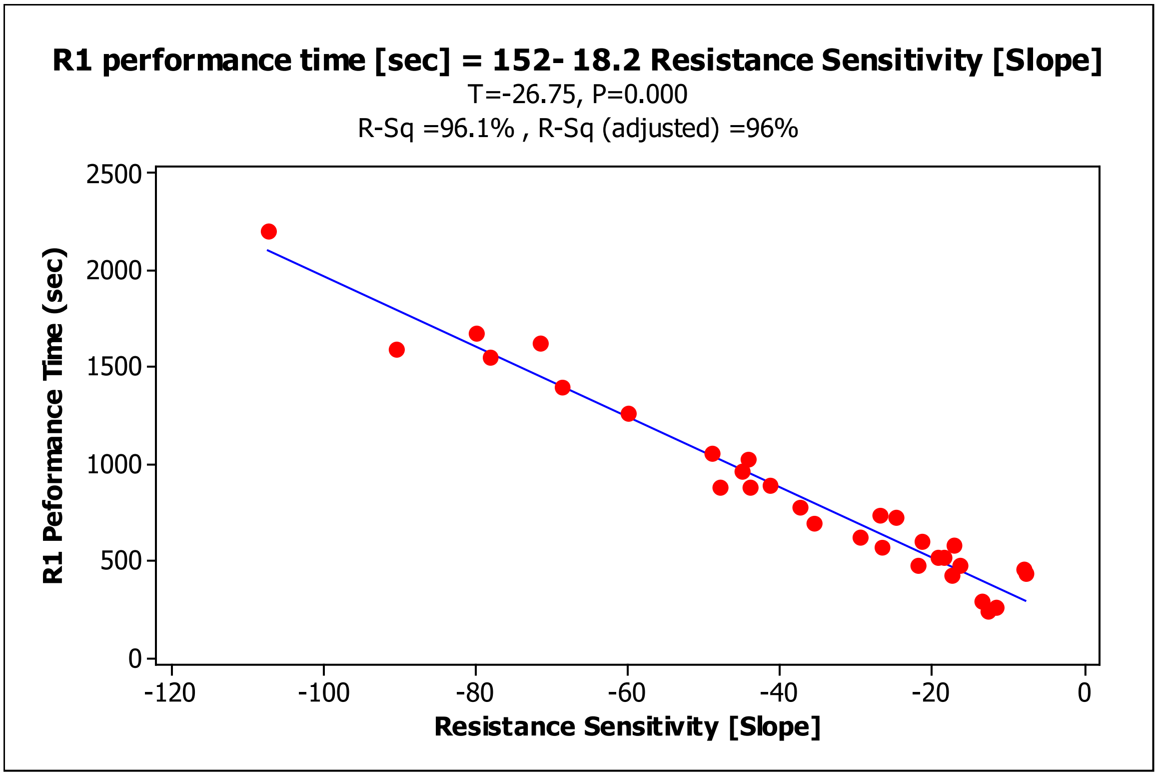

Contour Plot of R3time (sec) vs SN, TF
R3 Time [sec] = 133 - 117 SN + 121 TF
R-Sq = 21.0, R-Sq(adj) = 15.2, S = 55.21, P = 0.041
R3time (sec)
< 50
50 - 100
100 - 150
150 - 200
200 - 250
> 250
SN
TF
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9


Surface Plot of R3time (sec) vs TF, SN
R3 Time [sec] = 133 - 117 SN + 121 TF
R-Sq = 21.0, R-Sq (adj) = 15.2, S = 55.21, P = 0.041
R3 time (sec)
300
200
100
0
0.0
0.5
1.0
TF
0.4
0.6
0.8
1.0
SN

Appendix 2 (R1 time vs. Slope)

Regression Analysis: R1time (sec) versus Slope

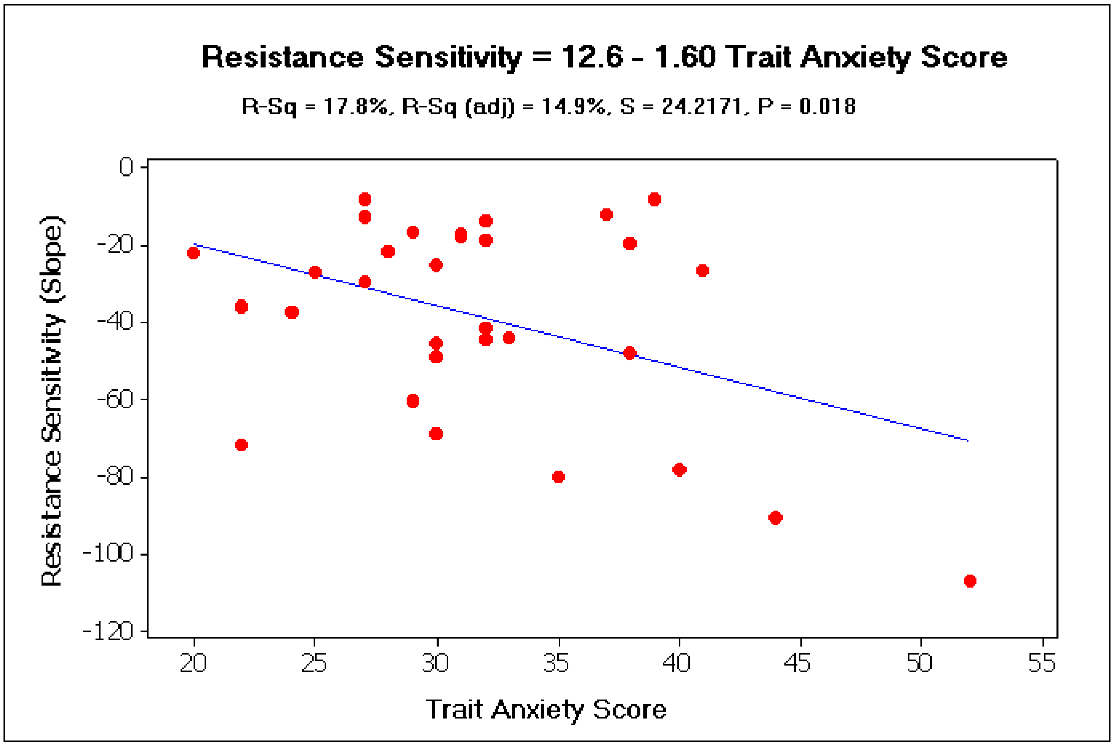
```
The regression equation is
R1time (sec) = 152 - 18.2 Resistance Sensitivity [Slope]


Predictor        Coef  SE Coef       T      P
Constant       152.28    31.55    4.83  0.000
Slope        -18.1933   0.6801  -26.75  0.000


S = 97.8159   R-Sq = 96.1%   R-Sq(adj) = 96.0%

PRESS = 334718   R-Sq(pred) = 95.30%


Analysis of Variance

Source          DF       SS       MS       F      P
Regression       1  6846159  6846159  715.53  0.000
Residual Error  29   277470     9568
Total           30  7123629


No replicates.
Cannot do pure error test.


Unusual Observations

            R1time
Obs  Slope   (sec)     Fit  SE Fit  Residual  St Resid
 18    -91  1597.0  1799.7    39.5    -202.7    -2.26R
 26   -107  2211.0  2102.9    49.9     108.1     1.29 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.72547
```


R1 performance time [sec] = 152- 18.2 Resistance Sensitivity [Slope]
T=-26.75, P=0.000
R-Sq =96.1% , R-Sq (adjusted) =96%
R1 Peformance Time (sec)
2500
2000
1500
1000
500
0
-120
-100
-80
-60
-40
-20
0
Resistance Sensitivity [Slope]

Appendix 3 (Resistance Sensitivity vs. Anxiety Score)

Regression Analysis: Resistance Sensitivity (Slope) versus Trait

```
The regression equation is
Slope = 12.6 - 1.60 Trait


Predictor      Coef  SE Coef      T      P
Constant      12.55    20.86   0.60  0.552
Trait       -1.6043   0.6408  -2.50  0.018


S = 24.2171   R-Sq = 17.8%   R-Sq(adj) = 14.9%

PRESS = 20816.1   R-Sq(pred) = 0.00%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       1   3676.0  3676.0  6.27  0.018
Residual Error  29  17007.6   586.5
  Lack of Fit   17  13033.0   766.6  2.31  0.072
  Pure Error    12   3974.6   331.2
Total           30  20683.6


 12 rows with no replicates


Unusual Observations

Obs  Trait    Slope     Fit  SE Fit  Residual  St Resid
 23   22.0   -71.57  -22.74    7.66    -48.83     -2.13R
 26   52.0  -107.22  -70.87   13.63    -36.34     -1.82 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 2.11864

No evidence of lack of fit (P >= 0.1).
```



Appendix 4 (R3 time vs. Anxiety Score)

Regression Analysis: R3time (sec) versus Trait

One subject was removed because outside 2.9 Standard Deviation

The regression equation is
R3time (sec) = 191 - 2.55 Trait

30 cases used, 1 cases contain missing values

Predictor	Coef	SE Coef	T	P
Constant	190.77	50.82	3.75	0.001
Trait	-2.552	1.573	-1.62	0.116

S = 58.3211   R-Sq = 8.6%   R-Sq(adj) = 5.3%

Analysis of Variance

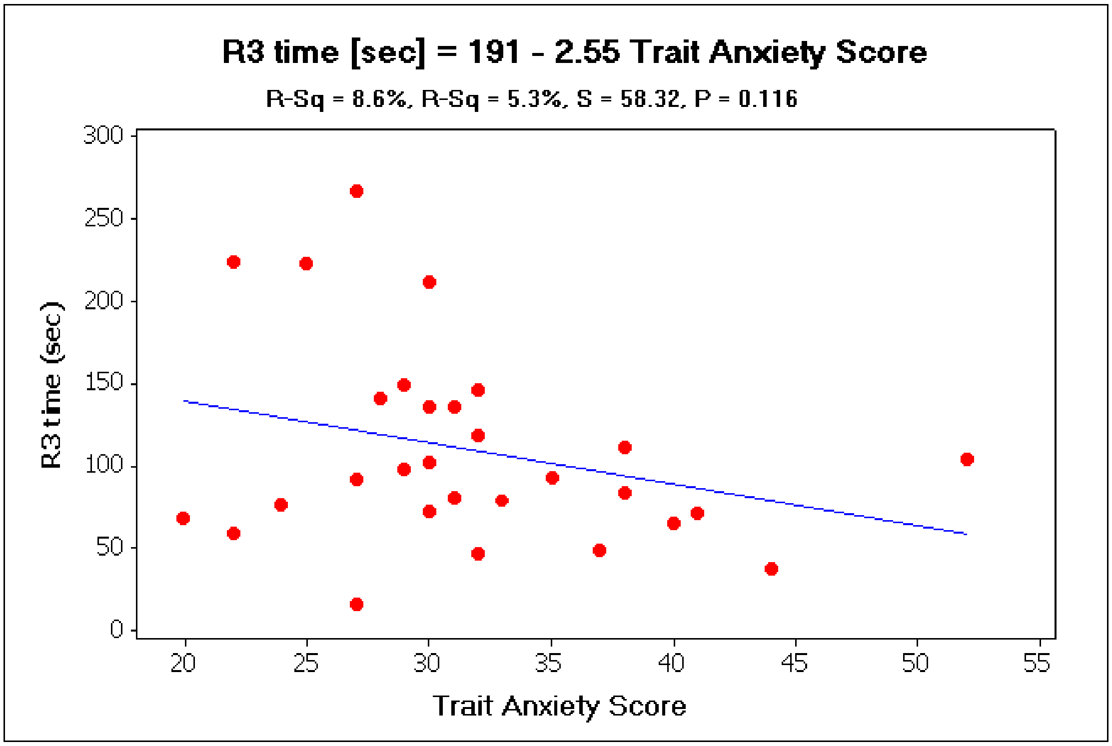
Source	DF	SS	MS	F	P
Regression	1	8956	8956	2.63	0.116
Residual Error	28	95238	3401		
Total	29	104193			

Unusual Observations

Obs	Trait	R3time (sec)	Fit	SE Fit	Residual	St Resid
7	27.0	268.0	121.9	12.9	146.1	2.57R
26	52.0	104.0	58.1	33.8	45.9	0.97 X

```
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

Scatterplot of R3time (sec) vs Trait Anxiety Score



Regression Analysis: R3time (sec) versus Trait (without removing 1 person)

```
The regression equation is
R3time (sec) = 191 - 2.55 Trait


30 cases used, 1 cases contain missing values


Predictor     Coef  SE Coef      T      P
Constant    190.77    50.82   3.75  0.001
Trait       -2.552    1.573  -1.62  0.116


S = 58.3211   R-Sq = 8.6%   R-Sq(adj) = 5.3%


Analysis of Variance

Source          DF      SS    MS     F      P
Regression       1    8956  8956  2.63  0.116
Residual Error  28   95238  3401
Total           29  104193
```

Unusual Observations

Obs	Trait	R3time (sec)	Fit	SE Fit	Residual	St Resid
7	27.0	268.0	121.9	12.9	146.1	2.57R
26	52.0	104.0	58.1	33.8	45.9	0.97 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Regression Analysis: R3time (sec) versus Trait

The regression equation is
R3time (sec) = 163 - 1.46 Trait

Predictor	Coef	SE Coef	T	P
Constant	163.04	59.73	2.73	0.011
Trait	-1.460	1.835	-0.80	0.433

S = 69.3370   R-Sq = 2.1%   R-Sq(adj) = 0.0%

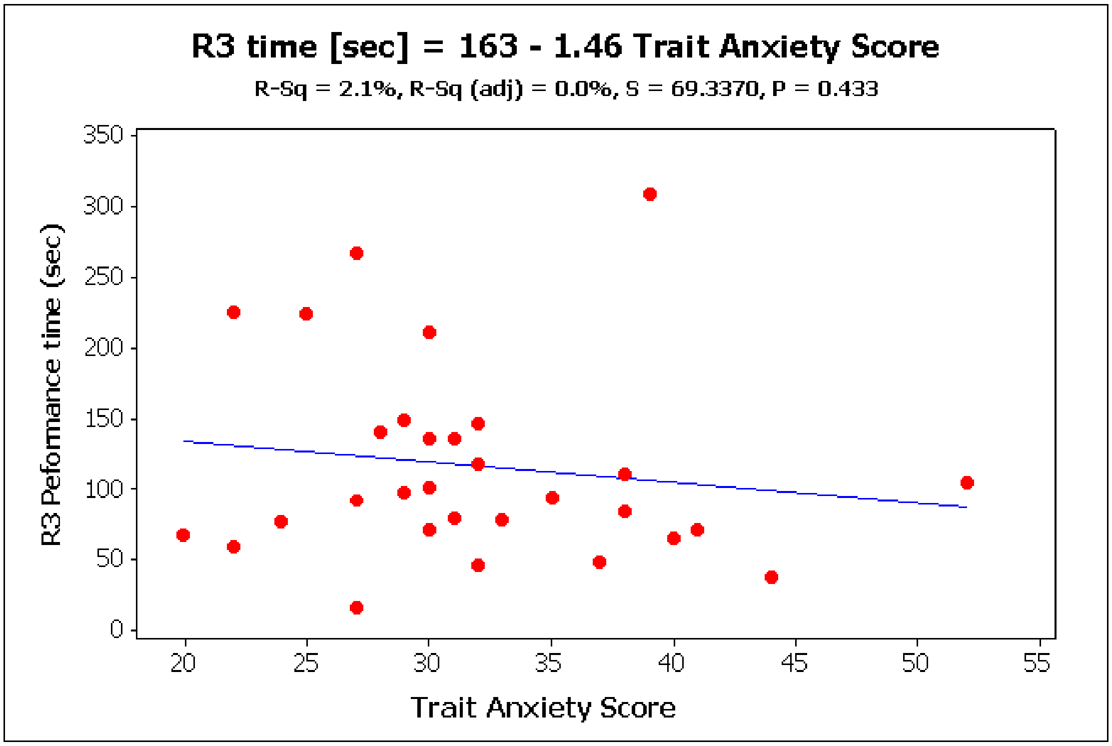
Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	3045	3045	0.63	0.433
Residual Error	29	139421	4808		
Total	30	142466			

Unusual Observations

Obs	Trait	R3time (sec)	Fit	SE Fit	Residual	St Resid
4	39.0	309.0	106.1	18.1	202.9	3.03R
7	27.0	268.0	123.6	15.3	144.4	2.13R
26	52.0	104.0	87.1	39.0	16.9	0.29 X

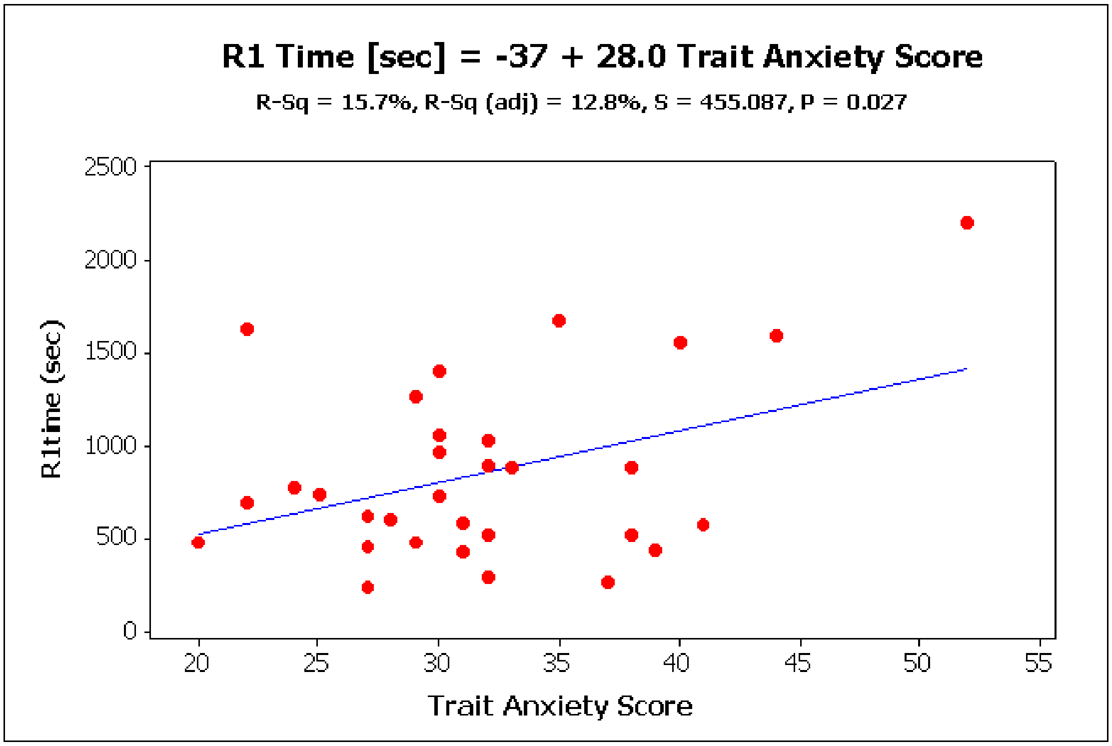
R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.



Appendix 5 (R1 Time vs. Anxiety Score)

Regression Analysis: R1time (sec) versus Trait

```
The regression equation is
R1time (sec) = - 37 + 28.0 Trait


Predictor    Coef  SE Coef      T      P
Constant    -37.4    392.0  -0.10  0.925
Trait       27.97    12.04   2.32  0.027


S = 455.087   R-Sq = 15.7%   R-Sq(adj) = 12.8%


Analysis of Variance

Source          DF       SS       MS     F      P
Regression       1  1117616  1117616  5.40  0.027
Residual Error  29  6006013   207104
Total           30  7123629


Unusual Observations

            R1time
Obs  Trait   (sec)     Fit  SE Fit  Residual  St Resid
 23   22.0  1629.0   578.0   143.9    1051.0     2.43R
 26   52.0  2211.0  1417.2   256.2     793.8     2.11RX

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

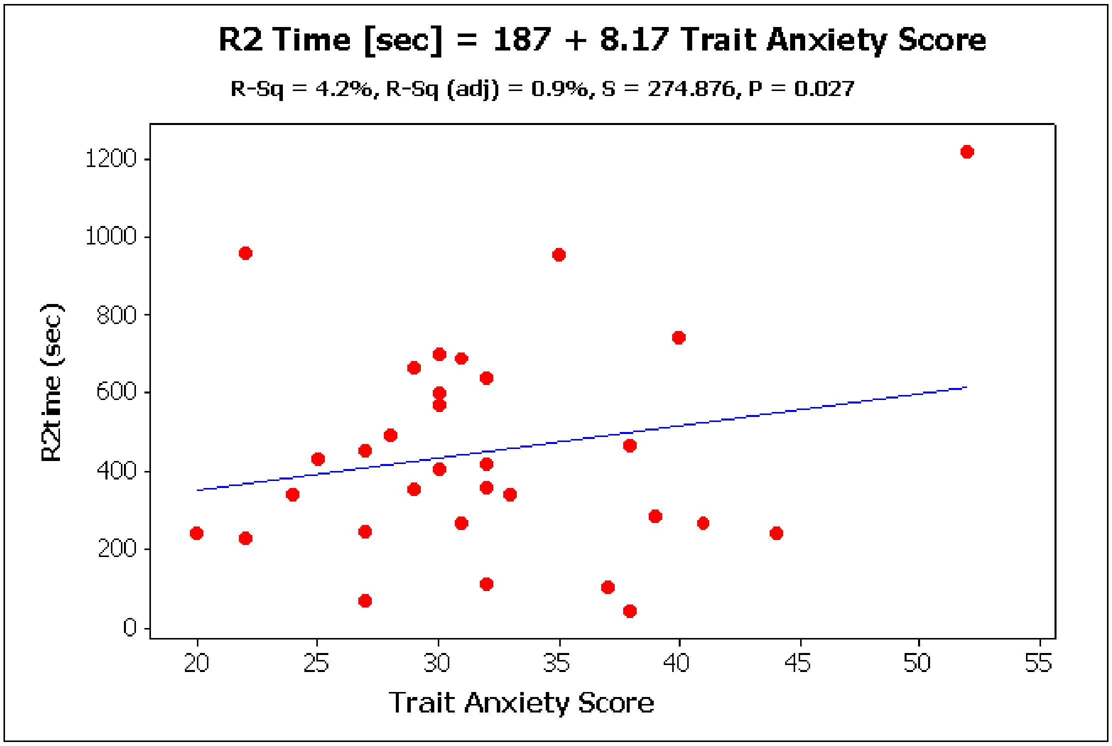


Appendix 6 (R2 time vs. Anxiety Score)

Regression Analysis: R2time (sec) versus Trait

```
The regression equation is
R2time (sec) = 187 + 8.17 Trait


Predictor    Coef  SE Coef     T      P
Constant    187.4    236.8  0.79  0.435
Trait       8.174    7.273  1.12  0.270


S = 274.876   R-Sq = 4.2%   R-Sq(adj) = 0.9%


Analysis of Variance

Source          DF       SS     MS     F      P
Regression       1    95413  95413  1.26  0.270
Residual Error  29  2191142  75557
Total           30  2286555


Unusual Observations

            R2time
```

```
Obs  Trait    (sec)     Fit  SE Fit  Residual  St Resid
 23   22.0    959.0  367.3    86.9     591.7      2.27R
 26   52.0   1216.0  612.5   154.7     603.5      2.66RX

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

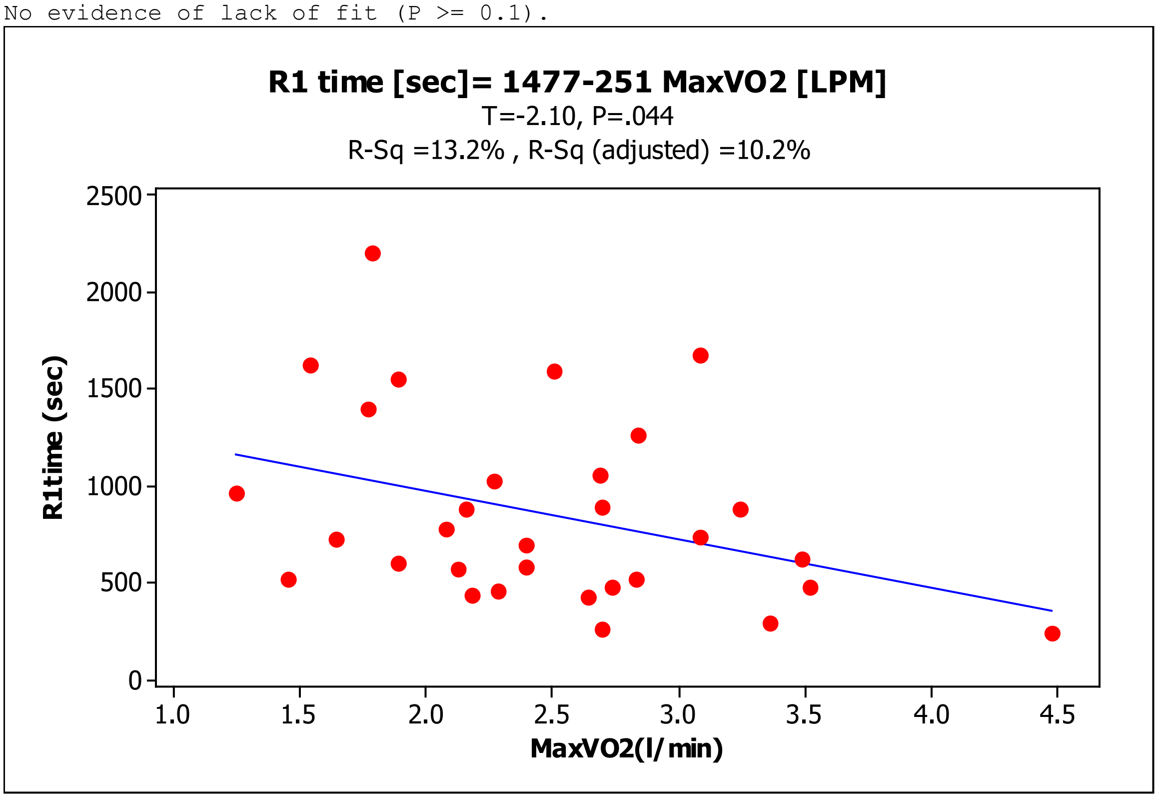


Appendix 7 (R1,R2,R3 Time vs. VO_{2max})

Regression Analysis: R1time (sec) versus MaxVO2(l/min)

```
The regression equation is
R1time (sec) = 1477 - 251 MaxVO2(l/min)


Predictor          Coef   SE Coef      T      P
Constant         1476.5     307.6   4.80  0.000
MaxVO2(l/min)    -250.8     119.2  -2.10  0.044


S = 461.646   R-Sq = 13.2%   R-Sq(adj) = 10.2%

PRESS = 6968370   R-Sq(pred) = 2.18%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       1   943231  943231  4.43  0.044
Residual Error  29  6180399  213117
  Lack of Fit   25  5066922  202677  0.73  0.729
  Pure Error     4  1113477  278369
```

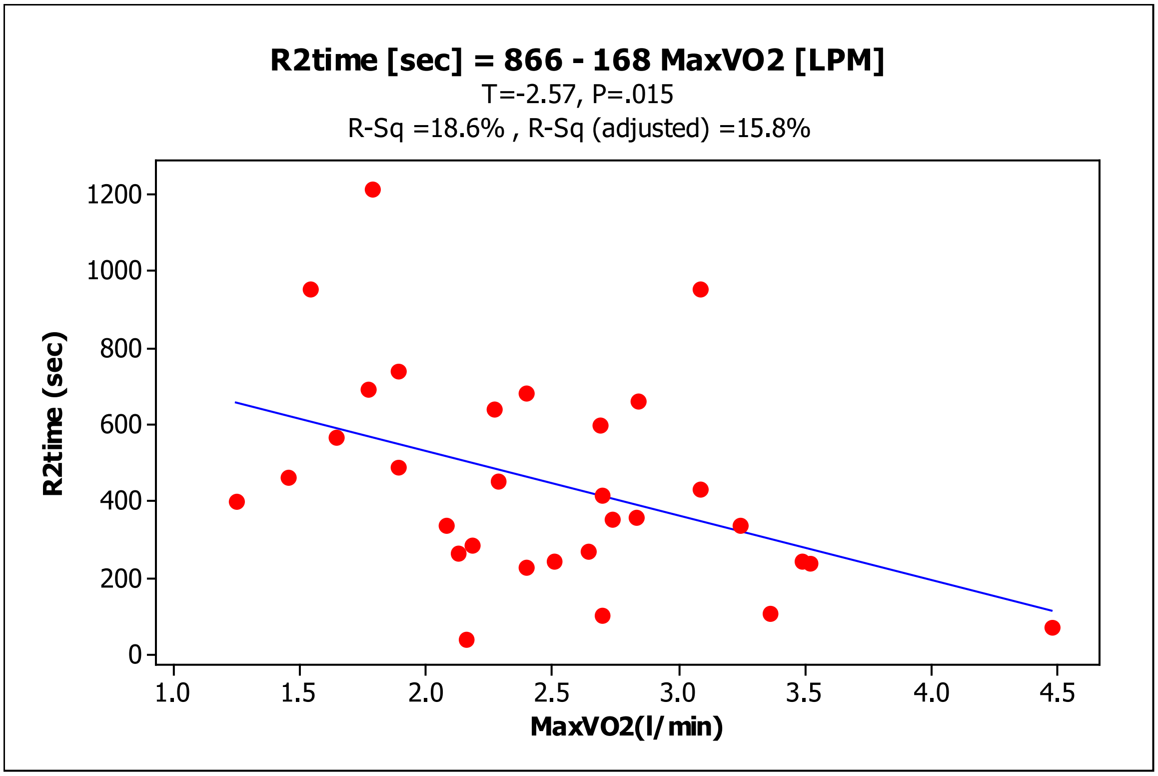
```
Total           30  7123629


 23 rows with no replicates


Unusual Observations

                    R1time
Obs  MaxVO2(l/min)   (sec)     Fit  SE Fit  Residual  St Resid
  6           3.08  1676.0   704.0   109.1     972.0     2.17R
 16           4.47   242.0   355.4   250.8    -113.4    -0.29 X
 26           1.79  2211.0  1027.5   117.2    1183.5     2.65R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.94134

No evidence of lack of fit (P >= 0.1).
```



Regression Analysis: R2time (sec) versus MaxVO2(l/min)

```
The regression equation is
R2time (sec) = 866 - 168 MaxVO2(l/min)


Predictor          Coef  SE Coef      T      P
Constant          866.1    168.8   5.13  0.000
```

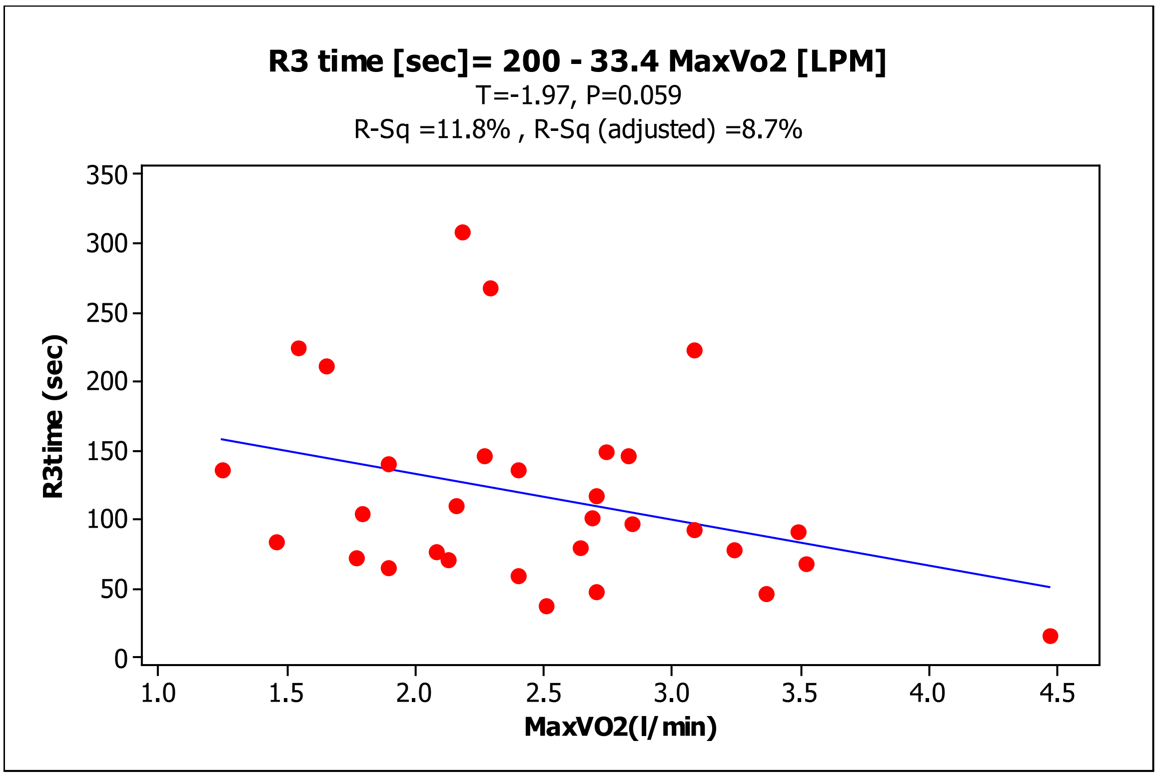
```
MaxVO2(l/min)  -168.37    65.43  -2.57  0.015


S = 253.358   R-Sq = 18.6%   R-Sq(adj) = 15.8%

PRESS = 2097770   R-Sq(pred) = 8.26%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       1   425032  425032  6.62  0.015
Residual Error  29  1861523   64190
  Lack of Fit   25  1541805   61672  0.77  0.702
  Pure Error     4   319718   79930
Total           30  2286555


 23 rows with no replicates


Unusual Observations

                     R2time
Obs  MaxVO2(l/min)    (sec)    Fit  SE Fit  Residual  St Resid
  6           3.08    954.0  347.5    59.9     606.5     2.46R
 16           4.47     70.0  113.5   137.6     -43.5    -0.20 X
 26           1.79   1216.0  564.7    64.3     651.3     2.66R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.57692

No evidence of lack of fit (P >= 0.1).
```



Regression Analysis: R3time (sec) versus MaxVO2(l/min)

```
The regression equation is
R3time (sec) = 200 - 33.4 MaxVO2(l/min)


Predictor          Coef  SE Coef      T      P
Constant         199.64    43.87   4.55  0.000
MaxVO2(l/min)    -33.44    17.00  -1.97  0.059


S = 65.8371   R-Sq = 11.8%   R-Sq(adj) = 8.7%

PRESS = 140277   R-Sq(pred) = 1.54%


Analysis of Variance

Source          DF      SS     MS     F      P
Regression       1   16764  16764  3.87  0.059
Residual Error  29  125701   4335
  Lack of Fit   25  108818   4353  1.03  0.558
  Pure Error     4   16883   4221
Total           30  142466


 23 rows with no replicates


Unusual Observations
```

```
                  R3time
Obs  MaxVO2(l/min)  (sec)    Fit  SE Fit  Residual  St Resid
  4           2.18  309.0  126.7    12.9     182.3     2.82R
  7           2.29  268.0  123.1    12.3     144.9     2.24R
 16           4.47   16.0   50.2    35.8     -34.2    -0.62 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.72028

No evidence of lack of fit (P >= 0.1).
```



Appendix 8 (R3 time vs. Sensing, Feeling, Anxiety)

Regression Analysis: R3time (sec) versus S, F, Trait

```
The regression equation is
R3time (sec) = 345 - 5.69 S - 6.63 F - 2.78 Trait


30 cases used, 1 cases contain missing values


Predictor     Coef  SE Coef      T      P
```

Constant	345.12	66.74	5.17	0.000
S	-5.694	2.533	-2.25	0.033
F	-6.626	2.345	-2.83	0.009
Trait	-2.785	1.398	-1.99	0.057

S = 51.5058   R-Sq = 33.8%   R-Sq(adj) = 26.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	35219	11740	4.43	0.012
Residual Error	26	68974	2653		
Total	29	104193			

Source	DF	Seq SS
S	1	5987
F	1	18705
Trait	1	10528

Unusual Observations

Obs	S	R3time (sec)	Fit	SE Fit	Residual	St Resid
7	8.0	268.00	158.12	17.15	109.88	2.26R
25	15.0	147.00	51.33	20.76	95.67	2.03R

R denotes an observation with a large standardized residual.

Appendix 9 (Anxiety, EI, SN, TF, JP vs. VO_{2max})

Regression Analysis: MaxVO2(l/min) versus EI, SN, TF, JP, Trait

The regression equation is
MaxVO2(l/min) = 2.92 + 0.632 EI + 0.602 SN + 0.299 TF - 0.871 JP - 0.0237 Trait

Predictor	Coef	SE Coef	T	P
Constant	2.9193	0.8220	3.55	0.002
EI	0.6320	0.5561	1.14	0.267
SN	0.6023	0.8348	0.72	0.477
TF	0.2989	0.7578	0.39	0.697
JP	-0.8714	0.9510	-0.92	0.368
Trait	-0.02367	0.01912	-1.24	0.227

S = 0.709125   R-Sq = 16.2%   R-Sq(adj) = 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	2.4223	0.4845	0.96	0.459
Residual Error	25	12.5715	0.5029		
Total	30	14.9938			

Source	DF	Seq SS
EI	1	1.1326
SN	1	0.0202
TF	1	0.0098
JP	1	0.4892
Trait	1	0.7704

Unusual Observations

Obs	EI	MaxVO2(l/min)	Fit	SE Fit	Residual	St Resid
16	0.90	4.470	2.883	0.257	1.587	2.40R
23	1.00	1.540	3.014	0.328	-1.474	-2.34R

R denotes an observation with a large standardized residual.

Regression Analysis: MaxVO2(l/min) versus EI, SN, JP, Trait

The regression equation is
MaxVO2(l/min) = 2.90 + 0.665 EI + 0.618 SN - 0.710 JP - 0.0231 Trait

Predictor	Coef	SE Coef	T	P
Constant	2.8977	0.8067	3.59	0.001
EI	0.6646	0.5409	1.23	0.230
SN	0.6176	0.8202	0.75	0.458
JP	-0.7098	0.8442	-0.84	0.408
Trait	-0.02312	0.01876	-1.23	0.229

S = 0.697515   R-Sq = 15.6%   R-Sq(adj) = 2.7%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	2.3441	0.5860	1.20	0.333
Residual Error	26	12.6497	0.4865		
Total	30	14.9938			

Source	DF	Seq SS
EI	1	1.1326
SN	1	0.0202
JP	1	0.4522
Trait	1	0.7390

Unusual Observations

Obs	EI	MaxVO2(l/min)	Fit	SE Fit	Residual	St Resid
16	0.90	4.470	2.909	0.244	1.561	2.39R
23	1.00	1.540	3.012	0.322	-1.472	-2.38R

R denotes an observation with a large standardized residual.

Regression Analysis: MaxVO2(l/min) versus EI, JP, Trait

The regression equation is

```
MaxVO2(l/min) = 3.01 + 0.713 EI - 0.308 JP - 0.0233 Trait


Predictor      Coef  SE Coef      T      P
Constant     3.0085   0.7868   3.82  0.001
EI           0.7131   0.5328   1.34  0.192
JP          -0.3076   0.6485  -0.47  0.639
Trait      -0.02330  0.01861  -1.25  0.221


S = 0.691899   R-Sq = 13.8%   R-Sq(adj) = 4.2%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       3   2.0682  0.6894  1.44  0.253
Residual Error  27  12.9255  0.4787
Total           30  14.9938


Source  DF  Seq SS
EI       1  1.1326
JP       1  0.1845
Trait    1  0.7510


Unusual Observations

Obs    EI  MaxVO2(l/min)    Fit  SE Fit  Residual  St Resid
 16  0.90          4.470  2.837   0.222     1.633      2.49R
 23  1.00          1.540  3.071   0.310    -1.531     -2.48R
 26  0.80          1.790  2.121   0.432    -0.331     -0.61 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

Regression Analysis: MaxVO2(l/min) versus EI, Trait

```
The regression equation is
MaxVO2(l/min) = 2.85 + 0.715 EI - 0.0243 Trait


Predictor      Coef  SE Coef      T      P
Constant     2.8483   0.7007   4.06  0.000
EI           0.7151   0.5253   1.36  0.184
Trait      -0.02431  0.01823  -1.33  0.193


S = 0.682256   R-Sq = 13.1%   R-Sq(adj) = 6.9%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       2   1.9605  0.9803  2.11  0.141
Residual Error  28  13.0332  0.4655
Total           30  14.9938


Source  DF  Seq SS
EI       1  1.1326
```

```
Trait     1  0.8279


Unusual Observations

Obs    EI  MaxVO2(l/min)    Fit  SE Fit  Residual  St Resid
 12  0.70          1.250  2.620   0.141    -1.370     -2.05R
 16  0.90          4.470  2.836   0.219     1.634      2.53R
 23  1.00          1.540  3.029   0.294    -1.489     -2.42R
 26  0.80          1.790  2.156   0.420    -0.366     -0.68 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

Regression Analysis: MaxVO2(l/min) versus EI

```
The regression equation is
MaxVO2(l/min) = 2.02 + 0.812 EI


Predictor    Coef  SE Coef     T      P
Constant   2.0190   0.3272  6.17  0.000
EI         0.8116   0.5273  1.54  0.135


S = 0.691353   R-Sq = 7.6%   R-Sq(adj) = 4.4%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       1   1.1326  1.1326  2.37  0.135
Residual Error  29  13.8611  0.4780
Total           30  14.9938


Unusual Observations

Obs    EI  MaxVO2(l/min)    Fit  SE Fit  Residual  St Resid
 15  0.00          1.890  2.019   0.327    -0.129     -0.21 X
 16  0.90          4.470  2.749   0.212     1.721      2.61R
 23  1.00          1.540  2.831   0.257    -1.291     -2.01R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

Appendix 10 (R3 Performance Time vs. Sensing + Feeling)

Regression Analysis: R3time (sec) versus S, F (outliers outside 2.9 std was removed)

```
The regression equation is
R3time (sec) = 254 - 5.85 S - 6.20 F


30 cases used, 1 cases contain missing values
```

Predictor	Coef	SE Coef	T	P	VIF
Constant	254.22	51.32	4.95	0.000	
S	-5.854	2.667	-2.19	0.037	1.1
F	-6.200	2.460	-2.52	0.018	1.1

S = 54.2634   R-Sq = 23.7%   R-Sq(adj) = 18.0%

PRESS = 99973.0   R-Sq(pred) = 4.05%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	24692	12346	4.19	0.026
Residual Error	27	79502	2945		
Total	29	104193			

No replicates.
Cannot do pure error test.

Source	DF	Seq SS
S	1	5987
F	1	18705

Unusual Observations

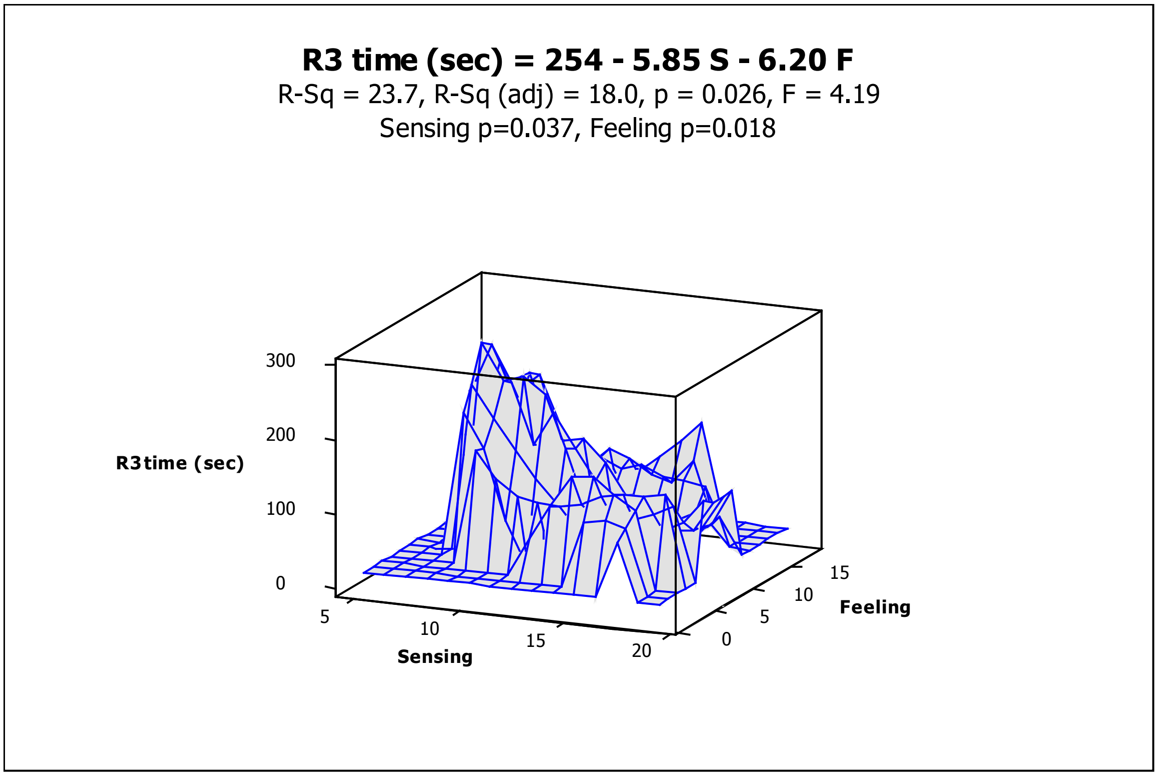
Obs	S	R3time (sec)	Fit	SE Fit	Residual	St Resid
7	8.0	268.00	145.39	16.77	122.61	2.38R

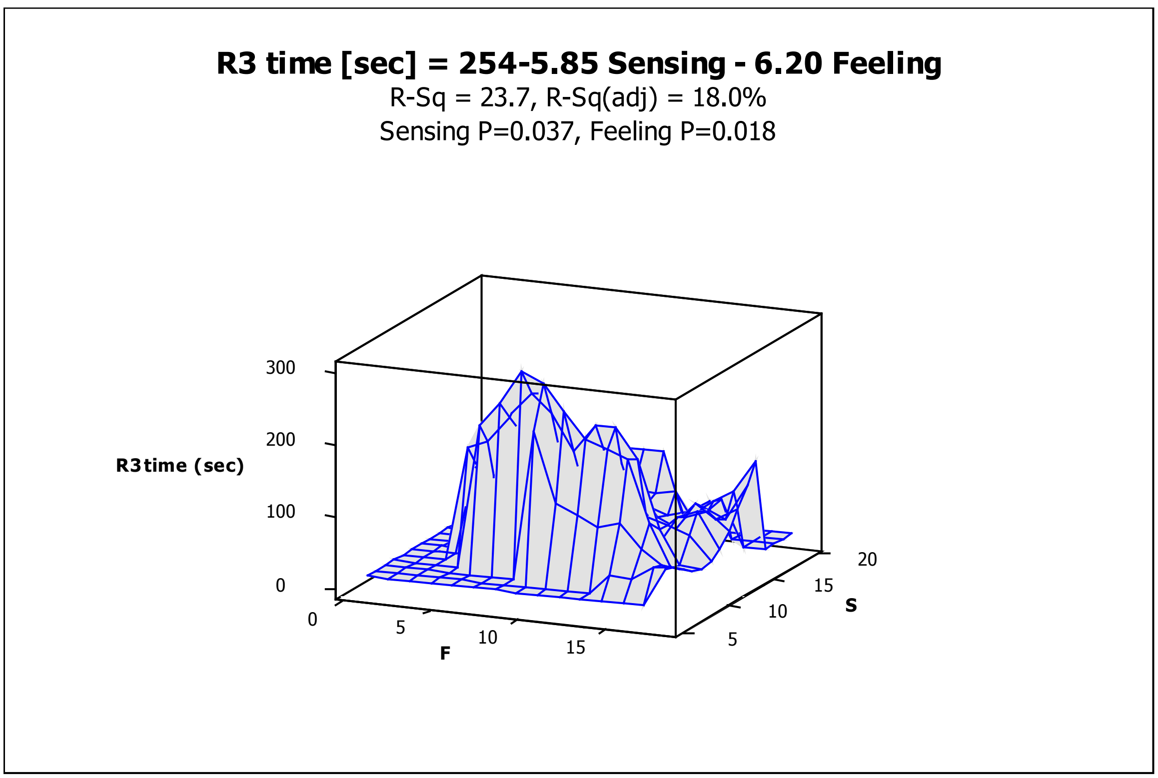
R denotes an observation with a large standardized residual.

Durbin-Watson statistic = 1.51405

Lack of fit test
Possible interaction in variable S (P-Value = 0.088)

Overall lack of fit test is significant at P = 0.088





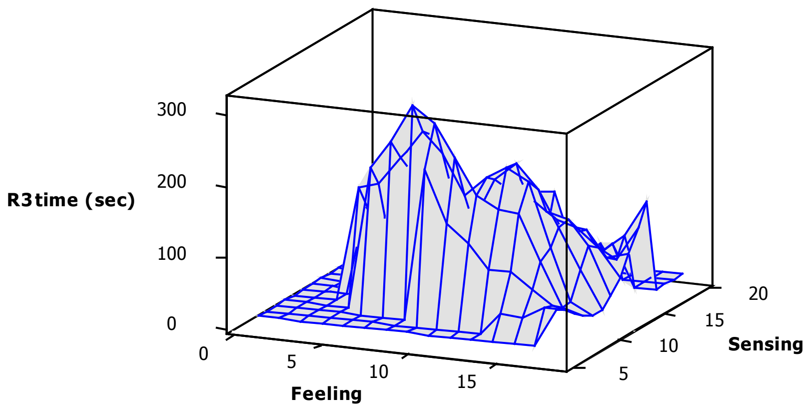
Regression Analysis: R3time (sec) versus S, F with the outlier outside 2.9 std.

```
The regression equation is
R3time (sec) = 269 - 6.73 S - 5.97 F


Predictor    Coef  SE Coef      T      P  VIF
Constant   268.68    60.52   4.44  0.000
S          -6.734    3.142  -2.14  0.041  1.1
F          -5.969    2.910  -2.05  0.050  1.1


S = 64.2060   R-Sq = 19.0%   R-Sq(adj) = 13.2%

PRESS = 139529   R-Sq(pred) = 2.06%


Analysis of Variance

Source          DF      SS     MS     F      P
Regression       2   27038  13519  3.28  0.053
Residual Error  28  115428   4122
  Lack of Fit   27  101316   3752  0.27  0.937
  Pure Error     1   14112  14112
Total           30  142466


 29 rows with no replicates


Source  DF  Seq SS
S        1    9689
F        1   17349


Unusual Observations

           R3time
Obs     S   (sec)    Fit  SE Fit  Residual  St Resid
  4  10.0   309.0  123.7    13.6     185.3     2.95R

R denotes an observation with a large standardized residual.


Durbin-Watson statistic = 1.73117

No evidence of lack of fit (P >= 0.1).
```

R3 time [sec] = 269 - 6.73 S - 5.97 F

R-sq = 19.0%; R-sq (adj) = 13.2%

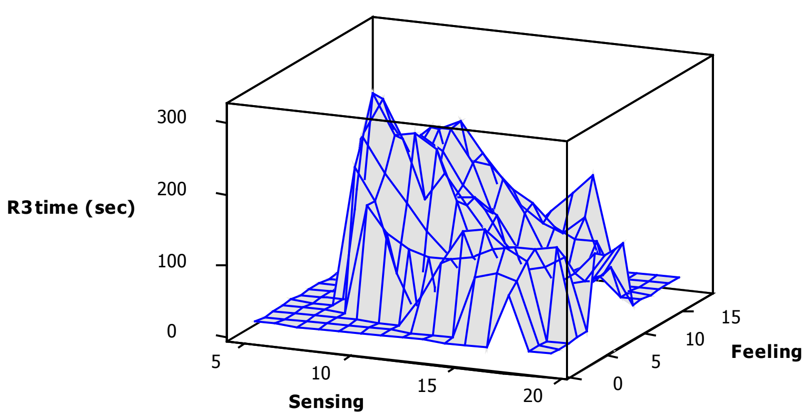
Sensing p=0.041; Feeling p=.050



R3 Time [sec] = 269 - 6.73 Sensing - 5.97 Feeling

R-sq = 19.0 , R-sq (adj) = 13.2%

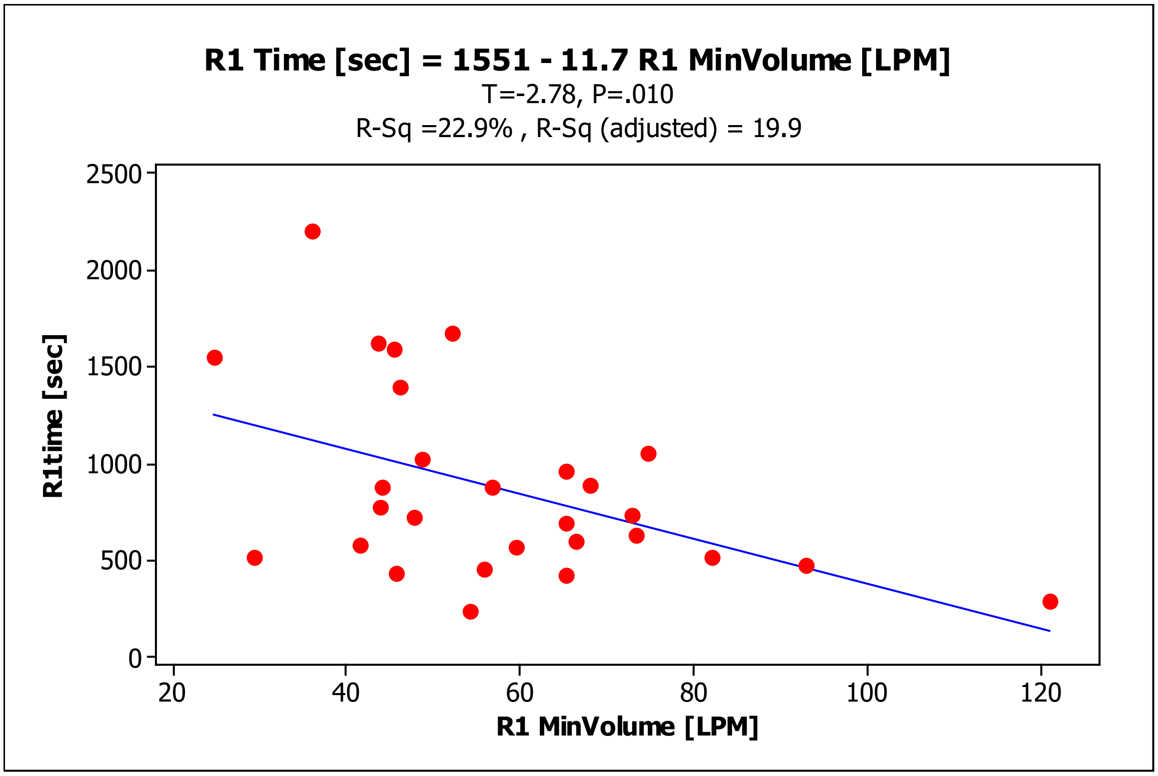
Sensing P=0.041; Feeling P=0.050



Appendix 11 (R1 Time vs. R1 Minute Volume)

Regression Analysis: R1time (sec) versus R1 LPM

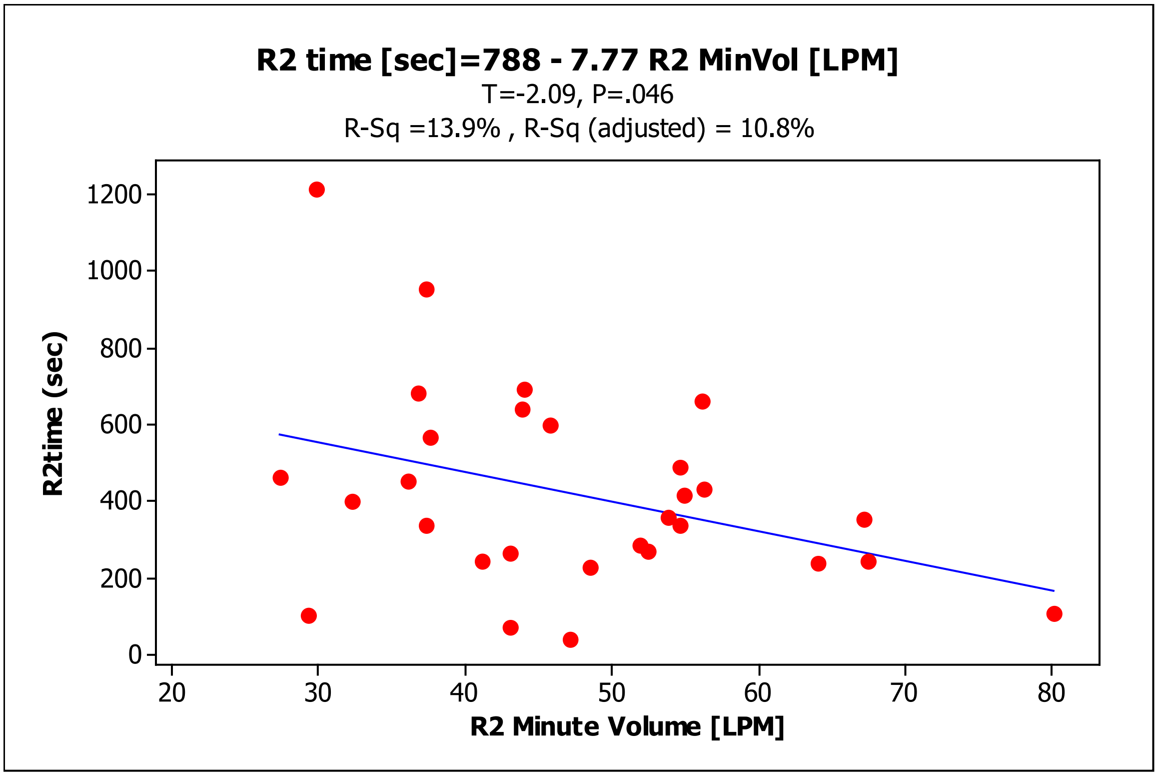
```
The regression equation is
R1time (sec) = 1551 - 11.7 R1 LPM


28 cases used, 3 cases contain missing values


Predictor      Coef  SE Coef      T      P
Constant     1550.7    257.6   6.02  0.000
R1 LPM      -11.687    4.209  -2.78  0.010


S = 437.521   R-Sq = 22.9%   R-Sq(adj) = 19.9%

PRESS = 5711736   R-Sq(pred) = 11.49%


Analysis of Variance

Source          DF       SS       MS     F      P
Regression       1  1475948  1475948  7.71  0.010
Residual Error  26  4977036   191424
  Lack of Fit   25  4942714   197709  5.76  0.320
  Pure Error     1    34322    34322
Total           27  6452984


 26 rows with no replicates


Unusual Observations

             R1time
Obs  R1 LPM   (sec)     Fit  SE Fit  Residual  St Resid
  1     121   290.0   136.2   278.0     153.8      0.46 X
 26      36  2211.0  1130.0   124.1    1081.0      2.58R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 2.58206

No evidence of lack of fit (P >= 0.1).
```


R1 Time [sec] = 1551 - 11.7 R1 MinVolume [LPM]
T=-2.78, P=.010
R-Sq =22.9% , R-Sq (adjusted) = 19.9
R1time [sec]
2500
2000
1500
1000
500
0
20
40
60
80
100
120
R1 MinVolume [LPM]

Appendix 12 (R2 time vs. R2 Minute Volume)

Regression Analysis: R2time (sec) versus R2 LPM

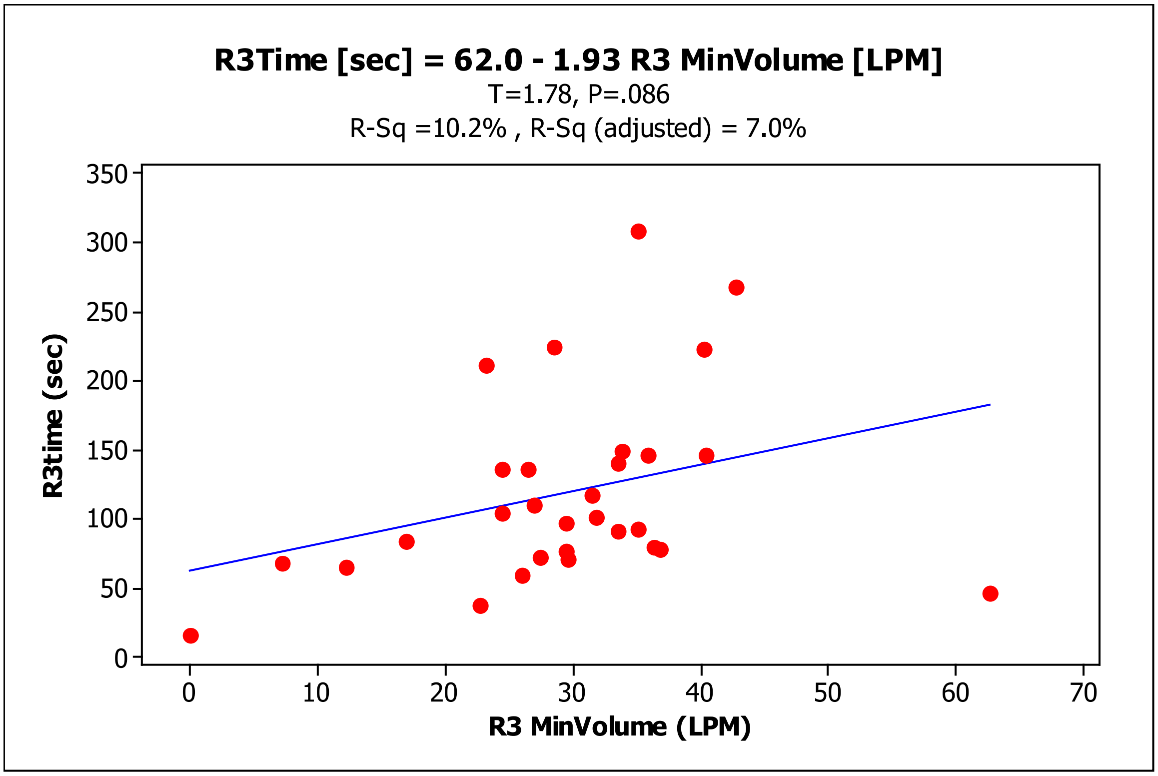
```
The regression equation is
R2time (sec) = 788 - 7.77 R2 LPM


29 cases used, 2 cases contain missing values


Predictor     Coef  SE Coef      T      P
Constant     788.2    181.9   4.33  0.000
R2 LPM      -7.770    3.715  -2.09  0.046


S = 247.512   R-Sq = 13.9%   R-Sq(adj) = 10.8%

PRESS = 1920613   R-Sq(pred) = 0.08%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       1   268027  268027  4.38  0.046
Residual Error  27  1654078   61262
Total           28  1922105


No replicates.
Cannot do pure error test.


Unusual Observations

             R2time
Obs  R2 LPM   (sec)    Fit  SE Fit  Residual  St Resid
  1    80.1   108.0  165.9   129.9     -57.9     -0.27 X
 26    29.9  1216.0  556.1    79.6     659.9      2.82R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.39276

No evidence of lack of fit (P >= 0.1).
```


R2 time [sec]=788 - 7.77 R2 MinVol [LPM]
T=-2.09, P=.046
R-Sq =13.9% , R-Sq (adjusted) = 10.8%
R2time (sec)
1200
1000
800
600
400
200
0
20
30
40
50
60
70
80
R2 Minute Volume [LPM]

Appendix 13 (R3 time vs. R3 Minute Volume)

Regression Analysis: R3time (sec) versus R3 LPM

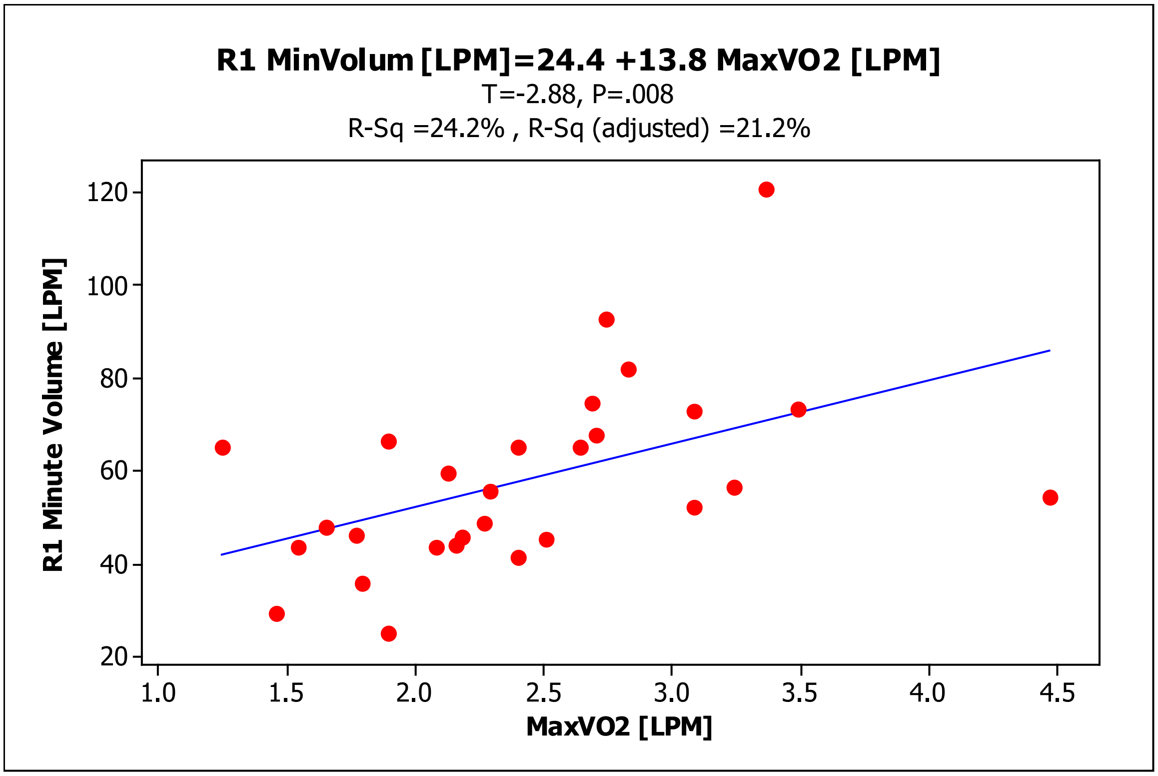
```
The regression equation is
R3time (sec) = 62.0 + 1.93 R3 LPM


30 cases used, 1 cases contain missing values


Predictor    Coef  SE Coef     T      P
Constant    61.97    34.15  1.81  0.080
R3 LPM      1.929    1.083  1.78  0.086


S = 66.4411   R-Sq = 10.2%   R-Sq(adj) = 7.0%

PRESS = 158685   R-Sq(pred) = 0.00%


Analysis of Variance

Source          DF      SS     MS     F      P
Regression       1   14006  14006  3.17  0.086
Residual Error  28  123604   4414
Total           29  137610


No replicates.
Cannot do pure error test.


Unusual Observations

             R3time
Obs  R3 LPM   (sec)    Fit  SE Fit  Residual  St Resid
  1    62.7    46.0  182.8    37.9    -136.8    -2.51RX
  4    35.1   309.0  129.7    13.6     179.3     2.76R
 16     0.0    16.0   62.0    34.1     -46.0    -0.81 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.93322

No evidence of lack of fit (P >= 0.1).
```


R3Time [sec] = 62.0 - 1.93 R3 MinVolume [LPM]
T=1.78, P=.086
R-Sq =10.2% , R-Sq (adjusted) = 7.0%
R3time (sec)
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
R3 MinVolume (LPM)

Appendix 14 (R1 Minute Volume vs. VO_{2max})

Regression Analysis: R1 LPM versus MaxVO2(l/min)

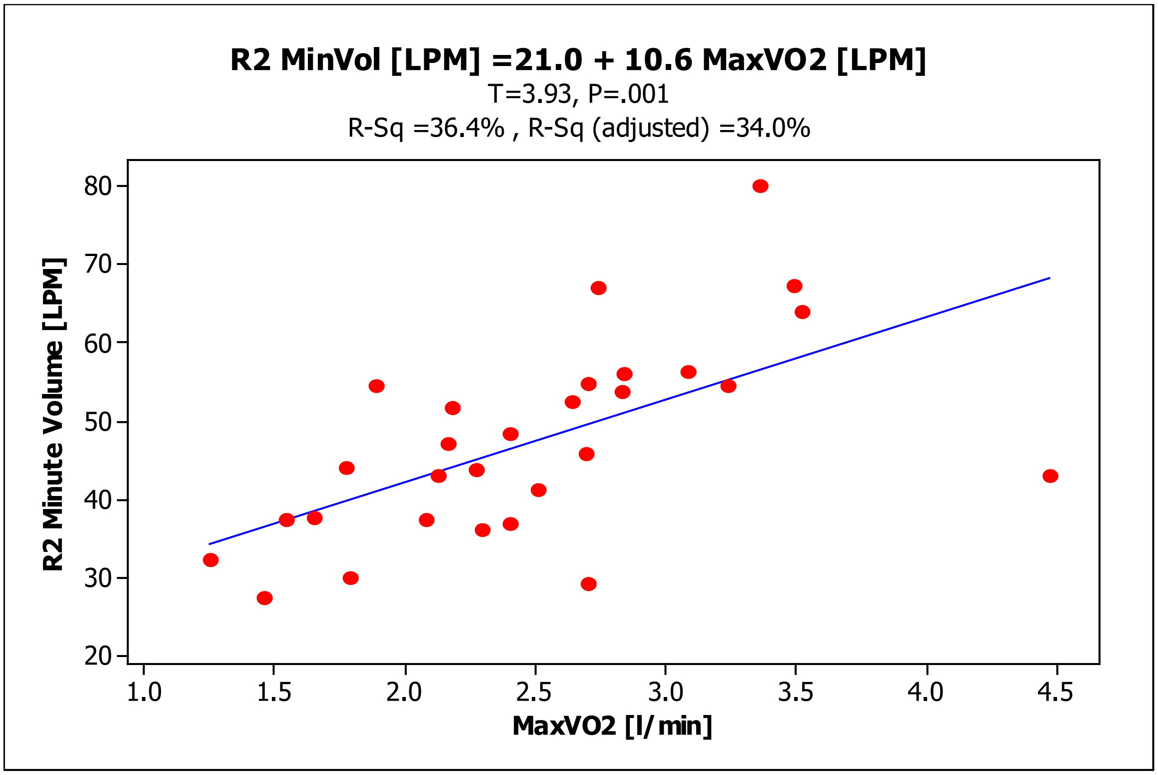
```
The regression equation is
R1 LPM = 24.4 + 13.8 MaxVO2(l/min)


28 cases used, 3 cases contain missing values


Predictor         Coef  SE Coef     T      P
Constant         24.41    12.14  2.01  0.055
MaxVO2(l/min)   13.822    4.804  2.88  0.008


S = 17.7543   R-Sq = 24.2%   R-Sq(adj) = 21.2%

PRESS = 10777.4   R-Sq(pred) = 0.26%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       1   2609.6  2609.6  8.28  0.008
Residual Error  26   8195.6   315.2
  Lack of Fit   23   6830.8   297.0  0.65  0.767
  Pure Error     3   1364.8   454.9
Total           27  10805.2


 22 rows with no replicates


Unusual Observations

Obs  MaxVO2(l/min)  R1 LPM    Fit  SE Fit  Residual  St Resid
  1           3.36  121.03  70.86    5.60     50.17     2.98R
 16           4.47   54.26  86.20   10.37    -31.94    -2.22RX

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.74297

Possible lack of fit at outer X-values (P-Value = 0.022)
Overall lack of fit test is significant at P = 0.022
```



Regression Analysis: R2time (sec) versus MaxVO2(l/min)

```
The regression equation is
R2time (sec) = 866 - 168 MaxVO2(l/min)


Predictor          Coef  SE Coef      T      P
Constant          866.1    168.8   5.13  0.000
MaxVO2(l/min)   -168.37    65.43  -2.57  0.015


S = 253.358   R-Sq = 18.6%   R-Sq(adj) = 15.8%

PRESS = 2097770   R-Sq(pred) = 8.26%


Analysis of Variance

Source          DF       SS      MS     F      P
Regression       1   425032  425032  6.62  0.015
Residual Error  29  1861523   64190
  Lack of Fit   25  1541805   61672  0.77  0.702
  Pure Error     4   319718   79930
Total           30  2286555


 23 rows with no replicates


Unusual Observations

                    R2time
```

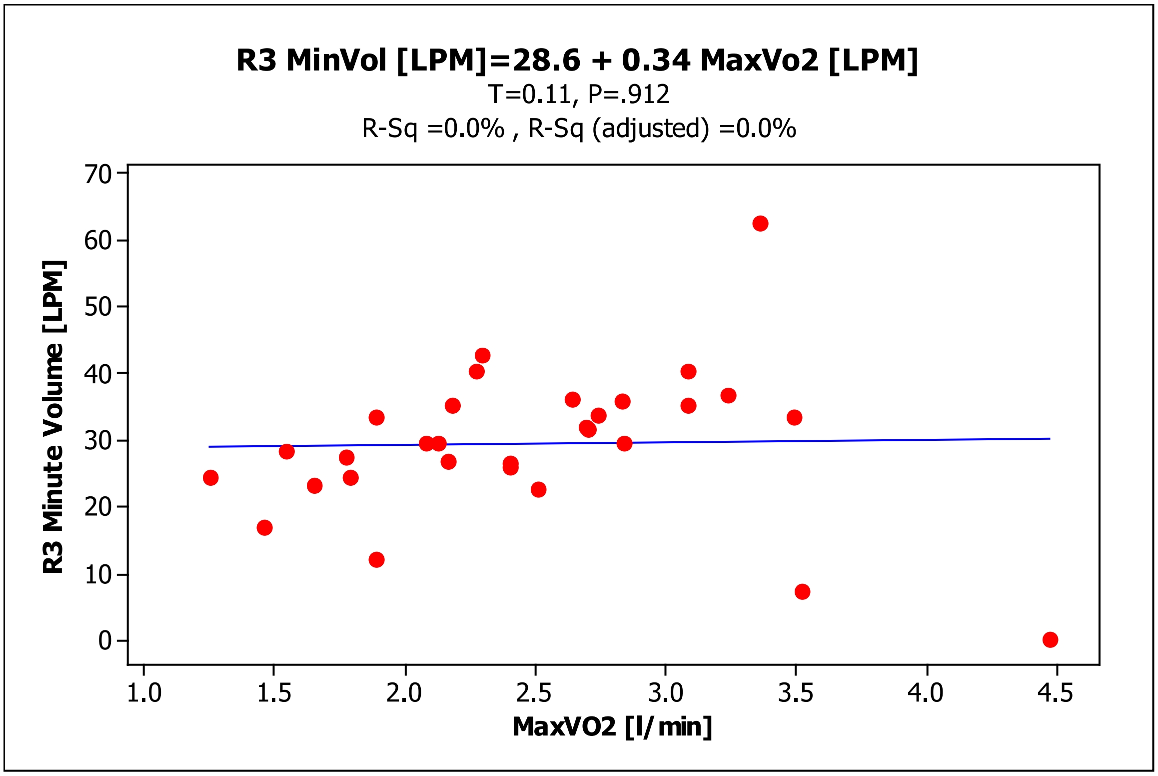
```
Obs  MaxVO2(l/min)    (sec)     Fit  SE Fit  Residual   St Resid
  6           3.08    954.0   347.5    59.9     606.5      2.46R
 16           4.47     70.0   113.5   137.6     -43.5     -0.20 X
 26           1.79   1216.0   564.7    64.3     651.3      2.66R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.57692

No evidence of lack of fit (P >= 0.1).
```



Appendix 15 (R3 minute Volume vs. VO_{2max})

Regression Analysis: R3 LPM versus MaxVO2(l/min)

```
The regression equation is
R3 LPM = 28.6 + 0.34 MaxVO2(l/min)


30 cases used, 1 cases contain missing values


Predictor          Coef  SE Coef     T      P
Constant         28.642    7.724  3.71  0.001
MaxVO2(l/min)     0.336    2.998  0.11  0.912


S = 11.5907   R-Sq = 0.0%   R-Sq(adj) = 0.0%

PRESS = 5201.17   R-Sq(pred) = 0.00%


Analysis of Variance

Source          DF      SS     MS     F      P
Regression       1     1.7    1.7  0.01  0.912
Residual Error  28  3761.6  134.3
  Lack of Fit   25  3522.7  140.9  1.77  0.357
  Pure Error     3   238.9   79.6
Total           29  3763.3


 24 rows with no replicates


Unusual Observations

Obs  MaxVO2(l/min)  R3 LPM    Fit  SE Fit  Residual  St Resid
  1           3.36   62.65  29.77    3.39     32.88     2.97R
 16           4.47    0.00  30.14    6.34    -30.14    -3.11RX
 24           3.52    7.27  29.82    3.77    -22.55    -2.06R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.


Durbin-Watson statistic = 1.61647


Lack of fit test
Possible curvature in variable MaxVO2(l  (P-Value = 0.081 )

Possible lack of fit at outer X-values (P-Value = 0.000)
Overall lack of fit test is significant at P = 0.000
```



R3 MinVol [LPM]=28.6 + 0.34 MaxVo2 [LPM]
T=0.11, P=.912
R-Sq =0.0% , R-Sq (adjusted) =0.0%
R3 Minute Volume [LPM]
70
60
50
40
30
20
10
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
MaxVO2 [l/min]

Appendix 16 (Stepwise procedure of R3 Time vs. E,I,S,N,T,F,J,P)

Regression Analysis: R3time (sec) versus E, I, S, N, T, F, J, P

```
* I is highly correlated with other X variables
* I has been removed from the equation.


* P is highly correlated with other X variables
* P has been removed from the equation.


The regression equation is
R3time (sec) = 1064 + 1.22 E - 45.1 S - 37.5 N - 3.50 T - 8.61 F + 1.28 J


Predictor    Coef  SE Coef      T      P
Constant     1064     1522   0.70  0.491
E           1.225    5.545   0.22  0.827
S          -45.06    75.66  -0.60  0.557
N          -37.55    74.66  -0.50  0.620
T          -3.499    9.274  -0.38  0.709
F          -8.612    8.970  -0.96  0.347
J           1.280    4.850   0.26  0.794


S = 68.5081   R-Sq = 20.9%   R-Sq(adj) = 1.2%


Analysis of Variance

Source          DF      SS    MS     F      P
Regression       6   29825  4971  1.06  0.414
Residual Error  24  112641  4693
Total           30  142466


Source  DF  Seq SS
E        1       6
S        1    9716
N        1     720
T        1   12749
F        1    6306
J        1     327


Unusual Observations

          R3time
Obs    E   (sec)    Fit  SE Fit  Residual  St Resid
  4  7.0   309.0  121.7    17.8     187.3     2.83R
 19  5.0   111.0  111.0    68.5      -0.0        * X
 20  2.0   212.0  212.0    68.5       0.0        * X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

Regression Analysis: R3time (sec) versus I, S, N, T, F, J, P

* P is highly correlated with other X variables
* P has been removed from the equation.

The regression equation is
R3time (sec) = 1076 - 1.22 I - 45.1 S - 37.5 N - 3.50 T - 8.61 F + 1.28 J

Predictor	Coef	SE Coef	T	P
Constant	1076	1526	0.71	0.487
I	-1.225	5.545	-0.22	0.827
S	-45.06	75.66	-0.60	0.557
N	-37.55	74.66	-0.50	0.620
T	-3.499	9.274	-0.38	0.709
F	-8.612	8.970	-0.96	0.347
J	1.280	4.850	0.26	0.794

S = 68.5081   R-Sq = 20.9%   R-Sq(adj) = 1.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	6	29825	4971	1.06	0.414
Residual Error	24	112641	4693		
Total	30	142466			

Source	DF	Seq SS
I	1	6
S	1	9716
N	1	720
T	1	12749
F	1	6306
J	1	327

Unusual Observations

Obs	I	R3time (sec)	Fit	SE Fit	Residual	St Resid
4	3.0	309.0	121.7	17.8	187.3	2.83R
19	5.0	111.0	111.0	68.5	-0.0	* X
20	8.0	212.0	212.0	68.5	0.0	* X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Regression Analysis: R3time (sec) versus S, N, T, F, J, P

* P is highly correlated with other X variables
* P has been removed from the equation.

The regression equation is
R3time (sec) = 1042 - 44.1 S - 36.6 N - 2.90 T - 8.13 F + 1.24 J

Predictor	Coef	SE Coef	T	P

Constant	1042	1489	0.70	0.491
S	-44.07	74.07	-0.59	0.557
N	-36.56	73.10	-0.50	0.621
T	-2.897	8.694	-0.33	0.742
F	-8.135	8.539	-0.95	0.350
J	1.236	4.753	0.26	0.797

S = 67.1921   R-Sq = 20.8%   R-Sq(adj) = 4.9%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	29596	5919	1.31	0.291
Residual Error	25	112870	4515		
Total	30	142466			

Source	DF	Seq SS
S	1	9689
N	1	688
T	1	12748
F	1	6166
J	1	305

Unusual Observations

Obs	S	R3time (sec)	Fit	SE Fit	Residual	St Resid
4	10.0	309.0	120.4	16.4	188.6	2.89R
19	19.0	111.0	111.0	67.2	0.0	* X
20	8.0	212.0	212.0	67.2	-0.0	* X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Regression Analysis: R3time (sec) versus S, N, T, F, P

The regression equation is
R3time (sec) = 1066 - 44.1 S - 36.6 N - 2.90 T - 8.13 F - 1.24 P

Predictor	Coef	SE Coef	T	P
Constant	1066	1473	0.72	0.476
S	-44.07	74.07	-0.59	0.557
N	-36.56	73.10	-0.50	0.621
T	-2.897	8.694	-0.33	0.742
F	-8.135	8.539	-0.95	0.350
P	-1.236	4.753	-0.26	0.797

S = 67.1921   R-Sq = 20.8%   R-Sq(adj) = 4.9%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	5	29596	5919	1.31	0.291
Residual Error	25	112870	4515		
Total	30	142466			

Source	DF	Seq SS
S	1	9689
N	1	688
T	1	12748
F	1	6166
P	1	305

Unusual Observations

Obs	S	R3time (sec)	Fit	SE Fit	Residual	St Resid
4	10.0	309.0	120.4	16.4	188.6	2.89R
19	19.0	111.0	111.0	67.2	-0.0	* X
20	8.0	212.0	212.0	67.2	-0.0	* X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Regression Analysis: R3time (sec) versus S, N, T, F

The regression equation is
R3time (sec) = 1118 - 46.1 S - 39.3 N - 3.46 T - 9.06 F

Predictor	Coef	SE Coef	T	P
Constant	1118	1433	0.78	0.442
S	-46.11	72.32	-0.64	0.529
N	-39.25	71.05	-0.55	0.585
T	-3.463	8.265	-0.42	0.679
F	-9.063	7.615	-1.19	0.245

S = 65.9763   R-Sq = 20.6%   R-Sq(adj) = 8.3%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	29291	7323	1.68	0.184
Residual Error	26	113175	4353		
Total	30	142466			

Source	DF	Seq SS
S	1	9689
N	1	688
T	1	12748
F	1	6166

Unusual Observations

Obs	S	R3time (sec)	Fit	SE Fit	Residual	St Resid
4	10.0	309.0	122.3	14.3	186.7	2.90R
19	19.0	111.0	111.0	66.0	0.0	* X
20	8.0	212.0	212.0	66.0	0.0	* X

R denotes an observation with a large standardized residual.

X denotes an observation whose X value gives it large influence.

Regression Analysis: R3time (sec) versus S, N, F

The regression equation is
R3time (sec) = 1106 - 48.8 S - 41.4 N - 6.13 F

Predictor	Coef	SE Coef	T	P
Constant	1106	1411	0.78	0.440
S	-48.82	70.92	-0.69	0.497
N	-41.44	69.77	-0.59	0.557
F	-6.132	2.957	-2.07	0.048

S = 64.9612   R-Sq = 20.0%   R-Sq(adj) = 11.1%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	28527	9509	2.25	0.105
Residual Error	27	113939	4220		
Total	30	142466			

Source	DF	Seq SS
S	1	9689
N	1	688
F	1	18150

Unusual Observations

Obs	S	R3time (sec)	Fit	SE Fit	Residual	St Resid
4	10.0	309.0	123.7	13.7	185.3	2.92R
19	19.0	111.0	111.0	65.0	0.0	* X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Regression Analysis: R3time (sec) versus S, F

The regression equation is
R3time (sec) = 269 - 6.73 S - 5.97 F

Predictor	Coef	SE Coef	T	P
Constant	268.68	60.52	4.44	0.000
S	-6.734	3.142	-2.14	0.041
F	-5.969	2.910	-2.05	0.050

S = 64.2060   R-Sq = 19.0%   R-Sq(adj) = 13.2%

Analysis of Variance

Source	DF	SS	MS	F	P

```
Regression       2   27038  13519  3.28  0.053
Residual Error  28  115428   4122
Total           30  142466


Source  DF  Seq SS
S        1    9689
F        1   17349


Unusual Observations

           R3time
Obs     S   (sec)    Fit  SE Fit  Residual  St Resid
  4  10.0   309.0  123.7    13.6     185.3      2.95R

R denotes an observation with a large standardized residual.
```

Appendix 17 (Subject Excel Data Key)

E	Extraversion
I	Introversion
EI	Extraversion-Introversion
S	Sensing
N	Intuition
SN	Sensing-Intuition
T	Thinking
F	Feeling
TF	Thinking-Feeling
J	Judging
P	Perceiving
JP	Judging-Perceiving
R1 time	R1 Performance time (sec)
R2 time	R2 Performance time (sec)
R3 time	R3 Performance time (sec)
Slope	Resistance sensitivity (sec/(cmH20*sec/L))
Abs Slope	Absolute Slope
R1VO2	R1 Condition Maximum Oxygen Consumption (L/min)
R2VO2	R2 Condition Maximum Oxygen Consumption (L/min)
R3VO2	R3 Condition Maximum Oxygen Consumption (L/min)
MaxVO2	Max Oxygen Consumption during VO_{2max} Test (L/min)
Weight	Mass of the individual (kg)
NormVO2	Normalized VO_{2max} in respect to weight (ml/min/kg)
R1 Percent	R1 Condition VO_{2max} ÷ VO_{2max} during VO_{2max} Test (%)
R2 Percent	R2 Condition VO_{2max} ÷ VO_{2max} during VO_{2max} Test (%)
R3 Percent	R3 Condition VO_{2max} ÷ VO2max during VO_{2max} Test (%)
VeSTPD R1	R1 Condition Maximum Minute Ventilation (L/min)
VeSTPD R2	R2 Condition Maximum Minute Ventilation (L/min)
VeSTPD R3	R3 Condition Maximum Minute Ventilation (L/min)
Trait	Trait Anxiety Score
Pre R1 St	R1 Condition Pre STAI Score
Post R1 St	R1 Condition Post STAI Score
R1Dif	R1 Condition Post STAI Score – R1 Condition Pre STAI Score
Pre R2 St	R2 Condition Pre STAI Score
Post R2 St	R2 Condition Post STAI Score
R2Dif	R2 Condition Post STAI Score – R2 Condition Pre STAI Score
Pre R3 St	R3 Condition Pre STAI Score
Post R3 St	R3 Condition Post STAI Score
R3Dif	R3 Condition Post STAI Score – R1 Condition Pre STAI Score
Sex	Gender of the individual Female = 0, Male = 1
Height	Height (cm)
MaxHR	Maximum Heart Rate During VO_{2max} Test.
Age	Age (years)

Subj	Subject #
Avg	Average
Stdev	Standard Deviation
Var	Variance
Max	Maximum
Min	Minimum

Appendix 18 (Subject Excel Data)

				EI			SN			TF			JP	R1	R2	R3
	Subject	E	I	EI	S	N	SN	T	F	TF	J	P	JP	R1time (sec)	R2time (sec)	R3time (sec)
1	145	9	1	0.90	6	14	0.30	5	15	0.25	11	9	0.55	290	108	46
2	265	7	3	0.70	19	1	0.95	14	6	0.70	19	1	0.95	584	686	136
3	290	3	7	0.30	10	10	0.50	10	10	0.50	11	9	0.55	517	357	147
4	292	7	3	0.70	10	10	0.50	7	13	0.35	9	11	0.45	432	286	309
5	293	4	6	0.40	18	2	0.90	12	8	0.60	18	2	0.90	1397	696	72
6	306	7	3	0.70	13	7	0.65	11	9	0.55	10	10	0.50	1676	954	93
7	324	6	4	0.60	8	12	0.40	10	10	0.50	17	3	0.85	454	453	268
8	325	3	7	0.30	11	9	0.55	12	8	0.60	9	11	0.45	734	435	224
9	328	9	1	0.90	16	4	0.80	9	11	0.45	15	5	0.75	884	339	79
10	329	6	4	0.60	10	10	0.50	7	13	0.35	8	12	0.40	598	492	141
11	331	6	4	0.60	7	13	0.35	3	17	0.15	6	14	0.30	700	229	59
12	332	7	3	0.70	13	7	0.65	10	10	0.50	14	6	0.70	962	402	136
13	333	6	4	0.60	14	6	0.70	9	11	0.45	10	10	0.50	423	268	80
14	337	7	3	0.70	17	3	0.85	9	11	0.45	18	2	0.90	259	104	48
15	338	0	#	0.00	15	5	0.75	11	9	0.55	16	4	0.80	1560	741	65
16	339	9	1	0.90	15	5	0.75	7	13	0.35	12	8	0.60	242	70	16
17	340	7	3	0.70	17	3	0.85	19	1	0.95	14	6	0.70	628	245	92
18	341	3	7	0.30	8	12	0.40	3	17	0.15	7	13	0.35	1597	242	37
19	346	5	5	0.50	19	0	1.00	9	11	0.45	18	2	0.90	882	42	111
20	347	2	8	0.20	8	12	0.40	6	5	0.55	16	4	0.80	729	568	212
21	351	5	5	0.50	17	3	0.85	5	15	0.25	15	5	0.75	775	339	77
22	353	4	6	0.40	11	9	0.55	9	11	0.45	12	8	0.60	480	355	149
23	358	10	0	1.00	9	11	0.45	7	13	0.35	9	11	0.45	1629	959	225
24	359	4	6	0.40	14	6	0.70	3	17	0.15	13	7	0.65	480	240	68
25	365	5	5	0.50	15	5	0.75	2	18	0.10	15	5	0.75	1027	640	147
26	366	8	2	0.80	14	6	0.70	15	5	0.75	16	4	0.80	2211	1216	104
27	376	8	2	0.80	12	8	0.60	3	17	0.15	5	15	0.25	1262	665	97
28	378	4	6	0.40	14	6	0.70	4	16	0.20	9	11	0.45	519	465	84
29	380	9	1	0.90	11	9	0.55	13	7	0.65	15	5	0.75	892	419	118
30	381	3	7	0.30	5	15	0.25	2	18	0.10	8	12	0.40	568	265	71
31	383	5	5	0.50	7	13	0.35	7	13	0.35	10	10	0.50	1059	598	102
	Avg	5.7	4	0.6	12	7.6	0.62	8	12	0.4	12	7.6	0.6	853.226	447.677	116.548
	Stdev	2.4	2	0.2	4	4	0.2	4	4	0.2	3.9	3.9	0.2	487.293	276.077	68.9119
	Var	5.7	6	0.1	16	16	0.04	17	18	0	15	15	0	237454	76218.5	4748.86
	Max	10	#	1	19	15	1	19	18	1	19	15	1	2211	1216	309
	Min	0	0	0	5	0	0.25	2	1	0.1	5	1	0.3	242	42	16

Appendix 18 (Subject Excel Data)

Slope	Abs Slope	Vo2 R1 R1Vo2(l/min)	V02 R2 R2VO2(l/min)	Vo2 R3 R3VO2(l/min)	VO2 Max MaxVO2(l/min)	Weight (kg)
-13.62	13.6220999	3.57	2.35	2.92	3.36	90.7
-17.13	17.1331395	1.8	1.68	1.61	2.4	59
-18.56	18.561584	2.31	1.79	1.62	2.83	68
-7.847	7.84680778	1.76	1.61	1.72	2.18	61
-68.78	68.7829427	1.06	1.52	0.98	1.77	57.2
-80.09	80.0900669	2.93		2.4	3.08	77.1
-7.896	7.89626148	1.75	1.23	1.96	2.29	54
-27	27.0020093	2.99	2.04	1.93	3.08	71.7
-43.94	43.9402193	1.92	2.41	1.92	3.24	81.7
-21.27	21.2712083	1.79	1.68	1.29	1.89	54
-35.66	35.6572726	2.44	1.75	1.16	2.4	63.5
-45.1	45.1006213	2.44	1.56	1.24	1.25	59
-17.33	17.3276651	2.49	2.39	2.12	2.64	76.2
-11.74	11.7366847		1.7		2.7	66.2
-78.11	78.1147464	1.03		0.6	1.89	52.6
-12.68	12.6790749	2.72	2.75		4.47	107
-29.62	29.6204587	3.16	3.37	2.11	3.49	68.1
-90.55	90.5490342	1.75	1.79	1.49	2.51	56.3
-47.83	47.8283651	1.94	2.12	1.47	2.16	59
-24.81	24.8059649	1.74	1.44	1.29	1.65	49.9
-37.44	37.4393947	1.58	1.68	1.77	2.08	49
-16.28	16.2775386	2.84	2.92	2.04	2.74	69.9
-71.57	71.5691423	1.72	1.91	1.54	1.54	65.8
-21.79	21.7854806		2.99	3.85	3.52	77.1
-44.26	44.2631399	2.04	1.33	2.2	2.27	63.5
-107.2	107.215451	1.44	1.5	1.49	1.79	59
-60.13	60.127564		2.75	1.87	2.84	72.6
-19.4	19.4001618	1.18	1.1	0.96	1.46	45.5
-41.33	41.3267326	2.74	2.76	2.09	2.7	73.5
-26.52	26.5236299	1.93	1.54	1.71	2.125	61.7
-48.86	48.8611222	2.62	2.13	1.87	2.69	61.7
-38.53	38.5275995	2.1314	1.9928	1.7662	2.485	65.532
26.257	26.2574411	0.6517	0.5867	0.6229	0.706959	12.8
689.45	689.453214	0.4247	0.3443	0.388	0.499792	163.84
-7.847	107.215451	3.57	3.37	3.85	4.47	107
-107.2	7.84680778	1.03	1.1	0.6	1.25	45.5

Appendix 19 (Subject Excel Data)

NormVO2 NormVO2(ml/min/kg)	VO2/VO2max R1 R1Percent	VO2/VO2max R2 R2Percent	VO2/VO2max R3 R3Percent	VeSTPD R1 R1 LPM	VeSTPD R2 R2 LPM	VeSTPD R3 R3 LPM
37.045204	1.0625	0.69940476	0.869047619	121.03	80.08	62.65
40.677966	0.75	0.7	0.670833333	41.52	36.75	26.54
41.617647	0.816254417	0.63250883	0.572438163	82.01	53.77	35.83
35.737705	0.80733945	0.73853211	0.788990826	45.81	51.85	35.1
30.944056	0.598870056	0.85875706	0.553672316	46.17	43.99	27.41
39.948119	0.951298701		0.779220779	52.13		35.15
42.407407	0.76419214	0.5371179	0.855895197	55.78	36.15	42.73
42.956764	0.970779221	0.66233766	0.626623377	72.9	56.22	40.32
39.657283	0.592592593	0.74382716	0.592592593	56.83	54.62	36.83
35	0.947089947	0.88888889	0.682539683	66.53	54.58	33.49
37.795276	1.016666667	0.72916667	0.483333333	65.24	48.47	25.96
21.186441	1.952	1.248	0.992	65.24	32.23	24.4
34.645669	0.943181818	0.90530303	0.803030303	65.21	52.44	36.27
40.785498	0	0.62962963	0		29.32	
35.931559	0.544973545	0	0.317460317	24.87		12.26
41.775701	0.608501119	0.61521253	0	54.26	43.11	0
51.248164	0.905444126	0.96561605	0.604584527	73.47	67.38	33.46
44.582593	0.697211155	0.71314741	0.593625498	45.54	41.18	22.72
36.610169	0.898148148	0.98148148	0.680555556	44.18	47.14	26.95
33.066132	1.054545455	0.87272727	0.781818182	47.79	37.61	23.1
42.44898	0.759615385	0.80769231	0.850961538	43.78	37.37	29.43
39.198856	1.03649635	1.06569343	0.744525547	92.94	67.11	33.8
23.404255	1.116883117	1.24025974	1	43.75	37.3	28.47
45.654994	0	0.84943182	1.09375		64	7.27
35.748031	0.898678414	0.58590308	0.969162996	48.67	43.91	40.34
30.338983	0.804469274	0.83798883	0.832402235	36	29.87	24.39
39.118457	0	0.96830986	0.658450704		56.19	29.49
32.087912	0.808219178	0.75342466	0.657534247	29.3	27.38	16.92
36.734694	1.014814815	1.02222222	0.774074074	68.05	54.88	31.51
34.440843	0.908235294	0.72470588	0.804705882	59.53	43.02	29.59
43.598055	0.973977695	0.79182156	0.695167286	74.67	45.72	31.86
37.625594	0.812999293	0.79230373	0.688032133	57.97143	47.3669	29.47467
6.1511676	0.364839305	0.23087103	0.2445977	20.00477	12.59158	11.39164
37.836863	0.133107719	0.05330143	0.059828035	400.191	158.5479	129.7694
51.248164	1.952	1.248	1.09375	121.03	80.08	62.65
21.186441	0	0	0	24.87	27.38	0

Appendix 20 (Subject Excel Data)

	Pre	Post		Pre	Post		Pre	Post
Trait	Stai	Stai		STAI	Stai		Stai	Stai
Trait	PreR1STAI	PostR1STAI	R1Dif	PreStaiR2	PostStaiR2	R2Dif	PreStaiR3	PostStaiR3
32	48	52	4	49	52	3		
31	33	25	-8	30	26	-4	26	26
32	37	35	-2				37	
39	41	47	6	38				
30							31	37
35	32	32	0	24	36	12	26	36
27	22	24	2					
25	34	26	-8	32			29	36
33	36	41	5	47				
28	24	32	8					
22	22	25	3	21	23	2	26	36
30	33	31	-2	24	29	5	25	
31	28	29	1	28	28	0	25	29
37	50	36	-14	40			56	58
40	52	51	-1	36	34	-2	36	35
27	25	25	0	23	31	8	23	33
27	28	27	-1	29	32	3	26	
44	36	32	-4	35	37	2	33	
38				41	42	1	26	33
30	27	27	0	24	27	3	20	22
24	27	24	-3	24	33	9	30	33
29	29	29	0	30	34	4	30	31
22	22	25	3	21	25	4	21	25
20	33	41	8	22	37	15	20	34
32	26	30	4	25	29	4	29	25
52	35	35	0		35		39	39
29	23			26	26	0	27	29
38	47	37	-10	45	45	0	46	49
32	45	52	7	32	52	20	35	52
41	20	31	11	27	31	4	62	41
30	31	34	3	38	31	-7	40	37
31.84	32.62069	33.3928571	0.428571	31.19231	33.69565	3.909091	31.69231	35.27273
6.9	9.029372	8.58654971	5.698789	8.318746	7.836017	6.062446	10.3025	8.800335
47.61	81.52956	73.728836	32.47619	69.20154	61.40316	36.75325	106.1415	77.44589
52	52	52	11	49	52	20	62	58
20	20	24	-14	21	23	-7	20	22

Appendix 21 (Subject Excel Data)

R3Dif	Sex Sex (F=0,M=1)	Height (cm)	MaxHR	Age
	1	176.53	168	32
0	0	157.48	199	23
	1	177.8	181	28
	1	165.1	191	19
6	0	185.42	189	26
10	1	182.88	186	23
	1	162.56	203	25
7	1	182.88	194	26
	1	180.34	203	21
	0	162.56	184	35
10	0	162.56	184	27
	0	162.56	196	22
4	1	172.72	176	39
2	0	170.18	182	22
-1	0	170.18	183	26
10	1	185.42	184	39
	1	175.26	201	21
	0	170.18	185	27
7	0	161.29	199	20
2	0	152.4	201	22
3	0	172.72	198	21
1	1	182.88	208	21
4	0	167.64	211	23
14	1	175.26	201	24
-4	0	162.56	187	19
0	0	167.64	172	19
2	1	180.34	192	20
3	0	158.75	197	25
17	1	182.88		23
-21	0	162.56	211	28
-3	1	175.26	201	21
3.3182	0.483870968	171.12	192.233	24.7
7.5806	0.508000508	9.2223	11.0911	5.32
57.465	0.258064516	85.05	123.013	28.3
17	1	185.42	211	39
-21	0	152.4	168	19

Appendix 22 (Excel Data of Inhalation Resistance)

	Flows (L/min)	Pressure (cmH2O)			
R1	0.48758	-0.23385	Pressure	Flow	Resistance (cmH20/(L/s))
R1	-10.8932	-0.33504	-3.9447	85	-2.78449
R1	-21.2393	-0.48684	Pressure was calculated using the best fit line function.		
R1	-57.4507	-1.3976			
R1	-68.3141	-1.80238			
R1	-178.5	-12.2255			
R1	-166.602	-10.5052			
R1	-156.256	-9.18967			
R1	-147.462	-8.2789			
R1	-140.22	-7.46934			
R1	-132.977	-6.60918			
R1	-127.804	-6.1032			
R1	-120.562	-5.34423			
R1	-115.906	-4.83825			
R1	-108.664	-4.38287			
R1	-102.456	-3.87689			
R1	-95.214	-3.32032			
R1	-86.4198	-2.76374			
R1	-78.6602	-2.30836			
R1	-68.3141	-1.80238			
R1	-56.9334	-1.347			
R2	-21.2393	-0.53743	Pressure	Flow	Resistance (cmH20/(L/s))
R2	-26.9296	-0.69935	-23.7906	85	-16.7934
R2	-37.2758	-1.06365	Pressure was calculated using the best fit line function.		
R2	-31.5854	-0.8562			
R2	-25.895	-0.67911			
R2	-44.0007	-1.41278			
R2	-60.5545	-2.47027			
R2	-65.2103	-2.83964			
R2	-72.4526	-3.54295			
R2	-81.7641	-4.62574			
R2	-86.9371	-4.32502			
R2	-99.8698	-8.57237			
R2	-112.285	-11.2136			
R2	-115.906	-11.7702			
R2	-121.597	-13.3387			
R2	-127.804	-14.9578			
R2	-136.598	-17.3359			
R2	-143.323	-19.6634			
R2	-154.187	-24.6726			
R2	-164.016	-28.6698			

R2	-172.81	-32.3635
R2	-176.431	-34.691
R2	-181.087	-36.3607
R3	1.522192	-0.23385
R3	-22.2739	-0.79042
R3	-31.5854	-1.2458
R3	-38.8277	-1.80238
R3	-44.518	-2.30836
R3	-49.1738	-2.86494
R3	-58.4853	-4.23108
R3	-66.2449	-5.85021
R3	-69.866	-7.16575
R3	-74.0045	-8.68369
R3	-78.1429	-10.151
R3	-81.2468	-11.163
R3	-85.3852	-12.3773
R3	-87.9717	-13.3893
R3	-91.5929	-14.7554
R3	-94.6967	-16.2228
R3	-98.3179	-17.6395
R3	-101.939	-20.0176
R3	-104.008	-21.9909
R3	-107.112	-23.863
R3	-110.216	-25.9376
R3	-113.32	-28.518
R3	-121.597	-33.8814
R3	-124.7	-37.1197
R3	-125.218	-38.1316
R3	-127.804	-40.2061
R3	-131.943	-41.8759
R3	-141.772	-49.7185
R3	-145.393	-51.8437
R3	-143.323	-50.1233
R3	-153.152	-57.5106
R3	-158.843	-62.6716
R3	-155.739	-61.4572
R3	-165.05	-65.6569

Pressure	Flow	Resistance (cmH20/(L/s))
-38.6282	85	-27.267

Pressure was calculated using the best fit line function.

Appendix 23 (IRB 03-0285)

UNIVERSITY OF MARYLAND

INSTITUTIONAL REVIEW BOARD

2100 Lee Building
College Park, Maryland 20742-5121
301.405.4212 TEL 301.314.9305 FAX

Reference: IRB HSR Identification Number 03-0285

August 4, 2003

MEMORANDUM

Notice of Results of Final Review by IRB on HSR Application

TO: Dr. Arthur T. Johnson
Dr. William Scott
Mr. Frank S. Koh
Department of Biological Resources Engineering

FROM: Dr. Phylis Moser-Veillon, Co-Chairperson
Dr. Joan A. Lieber, Co-Chairperson
Institutional Review Board

PROJECT ENTITLED:
"The Correlation Between Psychological Type and Performance Time While Wearing a Respirator"

The Institutional Review Board (IRB) concurs with the departmental Human Subjects Review Committee's (HSRC's) preliminary review of the application concerning the above referenced project. The IRB has approved the application and the research involving human subjects described therein. We ask that any future communications with our office regarding this research reference the IRB HSR identification number indicated above.

We ask that you not make any changes to the approved protocol without first notifying and obtaining the approval of the IRB. Also, please report any deviations from the approved protocol to the Chairperson of your departmental HSRC. If you have any questions or concerns, please do not hesitate to contact either of us at irb@deans.umd.edu. Thank you.

ADDITIONAL INFORMATION REGARDING IRB/HSRC APPROVALS

EXPIRATION OF IRB APPROVAL—Approval of non-exempt projects expires one year after the official date of IRB approval; approval of exempt projects expires three years after that date. If you expect to be collecting or analyzing data after the expiration of IRB approval, please contact the HSRC Chairperson in your department about submitting a renewal application. **(PLEASE NOTE: If you are not collecting data from human subjects and any on-going data analysis does not increase the risk to subjects, a renewal application would not be necessary.)**

STUDENT RESEARCHERS—Unless otherwise requested, the IRB will send copies of approval paperwork to the supervising faculty researcher (or advisor) of a project. We ask that such persons pass on that paperwork or a copy to any student researchers working on that project. That paperwork may be needed by students in order to apply for graduation. **PLEASE BE ADVISED THAT THE IRB MAY NOT BE ABLE TO PROVIDE COPIES OF THAT PAPERWORK, particularly if several years have passed since the date of the original approval.**

Enclosures (where appropriate), will include stamped copy of informed consent forms included in application and any copies of the application not needed by the IRB; copies of this memorandum and any consent forms to be sent to the Chairperson of the Human Subjects Review Committee

The Correlation between Psychological Type and Performance Time while Wearing a Respirator

I, ____________________, state that I am over 18 years of age, in good physical health, and wish to participate in a program of research being conducted by Arthur T. Johnson, Ph.D., and Frank (Chong S.) Koh at the University of Maryland, College Park, Department of Biological Resource Engineering.

The purpose of this investigation is to obtain information on how much performance decrement is attributable to specific dominant character traits of the individual.

I have been provided with this informed consent document, which describes the test procedures and methods. This document must be read and signed before I am permitted to participate in this investigation. Next, I will be asked to complete a brief medical history questionnaire. An investigator will be present to review the informed consent document and medical history questionnaire and to provide any answers to questions regarding this investigation.

Information about dominant character traits will be discerned by answering questions from Keirsey Temperament Sorter II (KTS-II). Other considerations are height, weight, age, sex, respiratory resistance, overall physical condition, and CO_2 sensitivity.

I will participate in exercise testing which may require me, at my discretion, to walk or run on a treadmill. During the orientation, I will be administered the KTS-II, CO_2 sensitivity and Maximal oxygen consumptions (VO_2 max). For CO_2 sensitivity, I will be required to empty my lung of air then take a deep breath and then hold as long as possible. This procedure will be repeated twice with 60-second breaks between the first and second attempts. In addition, I will place a 6 L breathing bag over my mouth and nose normally until my discretion for termination. Every thirty seconds, I will indicate my level of anxiety on a Visual Analog Scale (VAS) with "no anxiety at all" and "the worst anxiety ever" on a scale from 1-5 every thirty seconds. VO_2 max will be determined using a standard Bruce incremental treadmill exercise protocol. My maximal fitness capacity will be ascertained from an exercise test in which the speed and grade of the treadmill is incrementally increased every three minutes until I am too tired to continue exercising.

Three test conditions will follow. In each of the three conditions, I will don a respirator and exercise on the treadmill at 80% to 85% VO_2 max until fatigue. At that time, I will inform the investigators, and the testing will terminate. Each test condition will be scheduled as to give at least a day of rest. The respirator testing period will consist of a 5-10 minute warm-up period and a testing period which in total will take about 1 hour for each condition. The respirator's inhalation resistance would be changed for each of the

1 of 2
Initial after reading ______

session. Profile of Mood States (POMS) and Speilberger State-Trait inventory will be given pre and post all conditions CO_2 sensitivity. In summary there will be 4 conditions if you include VO_2 max session.

Any information collected is confidential and will be made accessible only to those individuals directly involved in the collection and analysis of this information. All personal information will be concealed by my personal identification number, which will be used whenever references are made regarding this investigation. Confidentiality is maintained by storing this information in the office of the investigators

Because this investigation involves strenuous exercise, risk of cardiovascular stress exists; however, I will be screened prior to testing to minimize this risk. An additional risk of falling or stumbling on the treadmill exists. The investigators will be present near the treadmill while I exercise to monitor my movement and to stabilize me if needed. Further, I will be informed of any adjustments to speed or grade of the treadmill prior to the change.

This investigation will not provide any monetary or short-term benefits to its participants. Instead, it is designed to help the investigators gather information and correlate between psychological type and performance time while wearing a respirator. I am free to ask questions or withdraw from this investigation at any time without fear of penalty. I may express this desire through written or verbal communication.

The University of Maryland does not provide any medical or hospitalization insurance for participants in this research study, nor will the University of Maryland provide any compensation for any injury sustained as a result of participation in this research study, except as required by law.

Principal investigators:
Arthur T. Johnson, Ph.D., P.E., and William H. Scott and Frank Koh
Department of Biological Resources Engineering, University of Maryland
College Park, MD 20742
(301) 405-1186

Name of subject ________________________

Signature of subject ________________________ Date ________________

2 of 2
Initial after reading ___

IRB APPROVED
VALID UNTIL
AUG 31 2004
UNIVERSITY OF MARYLAND
COLLEGE PARK

Inv.

UNIVERSITY OF MARYLAND, COLLEGE PARK
INSTITUTIONAL REVIEW BOARD

APPLICATION FOR INITIAL REVIEW OF RESEARCH USING HUMAN SUBJECTS

Name of Principal Investigator (NOT a student or fellow) Arthur T. Johnson, Ph.D., P.E. Tel. No. 301.405.1184

Name of Co-Investigator (NOT a student or fellow) William Scott Tel. No. 301.405.1199

E-Mail Address of P.I. aj16@umail.umd.edu E-Mail Address of of Co-P.I. fkoh@wam.umd.edu

Campus Address of P.I. Dept. of Biological Resources Engineering, UMCP Zip 20742

Name of Student Investigator (Student, Fellow, Post-Doctoral Fellow) Frank S. Koh Tel No. 301-405-1186

Student Identification No. 215 - 90 - 2996

Department Biological Resources Engineering Project Duration (mm/yyyy – mm/yyyy) 10/02 - 10/04

Project Title The Correlation between Psychological Type and Performance Time while Wearing a Respirator

Funding Agency NIOSH UM Proposal # (s) 0207028245

CONFLICT OF INTEREST: Investigators ☐ do ☒ do not have a real or potential conflict of interest.
If yes, please respond to question number seven listed on page two.

Please attach a copy of your responses to items 1 – 7 of the instructions (on page 2 of this document), including all related documents, such as questionnaires, interview questions, surveys, etc.

Please indicate whether this research should be exempt or non-exempt from further human subjects review and indicate which of the six exemption reasons (described on page 3 of this document) justifies an exemption status:

☐ Exempt (list all possible categories) ________ ☒ Non-Exempt

If exempt, please briefly describe the reason (s) for exemption. Your notation is simply a suggestion to the IRB.

4/28/03 [signature]
Date — Principal Investigator's signature (University of Maryland, College Park, employee)

4/28/03 [signature]
Date — Co-Investigator's signature

4-28-03 [signature]
Date — Student Investigator's signature

7-7-03 [signature: M. A. Rogers]
Date — Department Chair or Departmental Human Subjects Review Committee Chair (Either signature is required.)

PLEASE ATTACH THIS COVER PAGE TO EACH SET OF COPIES.
SEND FOUR (4) COPIES WITH ONE CONTAINING ORIGINAL SIGNATURES
To inquire about the status of applications, post e-mails to irb@deans.umd.edu

IRB-1
02/2002

The Correlation between Psychological Type and Performance Time while Wearing a Respirator

I, ____________________, state that I am over 18 years of age, in good physical health, and wish to participate in a program of research being conducted by Arthur T. Johnson, Ph.D., and Frank (Chong S.) Koh at the University of Maryland, College Park, Department of Biological Resource Engineering.

The purpose of this investigation is to obtain information on how much performance decrement is attributable to specific character traits of the individual.

I have been provided with this informed consent document, which describes the test procedures and methods. This document must be read and signed before I am permitted to participate in this investigation. Next, I will be asked to complete a brief medical history questionnaire. An investigator will be present to review the informed consent document and medical history questionnaire and to provide any answers to questions regarding this investigation.

Information about dominant character traits will be discerned by answering questions from Keirsey Termperament Sorter II (KTS-II). Other considerations are height, weight, age, sex, respiratory resistance, overall physical condition, and CO_2 sensitivity.

I will participate in exercise testing which may require me, at my discretion, to walk or run on a treadmill. During the orientation, I will be administered the KTS-II, CO_2 sensitivity and Maximal oxygen consumptions (VO_2 max). For CO_2 sensitivity, I will be required to empty my lung of air then take a deep breath and then hold as long as possible. This procedure will be repeated twice with 60-second breaks between the first and second attempts. In addition, I will place a 6 L breathing bag over my mouth and nose normally until my discretion for termination. Every thirty second, I will indicate my level of anxiety on a Visual Analog Scale (VAS) with "no anxiety at all" and "the worst anxiety ever" on a scale from 1-5 every thirty seconds. VO_2 max will be determined using a standard Bruce incremental treadmill exercise protocol. My maximal fitness capacity will be ascertained from an exercise test in which the speed and grade of the treadmill is incrementally increased every three minutes until I am too tired to continue exercising.

Three test conditions will follow. In each of the three conditions, I will don a respirator and exercise on the treadmill at 80 to 85% VO_2 max until fatigue. At that time, I will inform the investigators, and the testing will terminate. Each test condition will we be scheduled as to give at least a day of rest. The respirator testing period will consist of a 5-10 minute warm-up period and a testing period which in total will take about 1 hour for each condition. The respirator's inhalation resistance would be changed for each of the session. Profile of Mood States (POMS) and Speilberger State-Trait Inventory will be given pre and post all conditions including CO_2 sensitivity.

Any information collected is confidential and will be made accessible only to those individuals directly involved in the collection and analysis of this information. All personal information will be concealed by my personal identification number, which will be used whenever references are made regarding this investigation. Confidentiality is maintained by storing this information in the office of the investigators

Because this investigation involves strenuous exercise, risk of cardiovascular stress exists; however, I will be screened prior to testing to minimize this risk. An additional risk of falling or stumbling on the treadmill exists. The investigators will be present near the treadmill while I exercise to monitor my movement and to stabilize me if needed. Further, I will be informed of any adjustments to speed or grade of the treadmill prior to the change.

This investigation will not provide any monetary or short-term benefits to its participants. Instead, it is designed to help the investigators gather information and correlate between psychological type and performance time while wearing a respirator. I am free to ask questions or withdraw from this investigation at any time without penalty. I may express this desire through written or verbal communication.

The University of Maryland does not provide any medical or hospitalization insurance for participants in this research study, nor will the University of Maryland provide any compensation for any injury sustained as a result of participation in this research study, except as required by law.

Principal investigators:
Arthur T. Johnson, Ph.D., P.E., and William H. Scott and Frank Koh
Department of Biological Resources Engineering, University of Maryland
College Park, MD 20742
(301) 405-1186
aj16@umd.edu

If you have any questions about your rights as a research subject contact:
Marc Rogers, Ph.D. chair
Human Subjects Review Committee
301-405-2484
mrogers1@umd.edu

Name of subject ________________________

Signature of subject ________________________ Date ________________

1. **Abstract.** Provide an abstract (200 words) that describes the purpose of this research and summarizes the strategies used to protect human subjects.

The brain unconsciously defaults to specific thinking templates. Some subjects tolerate or adapt to wearing a respirator more so then others. So, how much performance decrement is attributable to specific dominant character traits? The subjects will be tested for dominant character traits and perform on a treadmill at 80-85 % of their VO_2 max until they reach a voluntary end point, with modified respirator resistance. Other considerations are height, weight, age, sex, respiratory resistance, overall physical condition, and CO_2 sensitivity.

The investigation involves an orientation period followed by a testing period. During the orientation period, participants will complete a medical history form and review an informed consent document, which will outline the procedures and methods of the investigation. In addition, the subject will be given 4 different personality tests. In the testing periods, participants will exercise on a treadmill while donning respirator masks with one of three different inhalation resistances.

Providing each subject a reference identification number will ensure subject confidentiality and protection. Only those individuals involved in data collection and analysis will have access to this information.

2. **Subject Selection**

a. Who will be the subjects? How will you enlist their participation? If you plan to advertise for subjects, please include a copy of the advertisement.

Prospective participants both female and male will be recruited or asked to volunteer from the Biological Resources Engineering Department at the University of Maryland, College Park. Previously tested subjects will be selected by reviewing the subject database maintained in the Human Performance laboratory in this department. Between ten and twenty-five individuals will be selected to take part in this study. A diverse range of personality traits and performance characteristics would be preferred.

b. Will the subjects be selected for any specific characteristics (e.g., age, sex, race, ethnic origin, religion, or any social or economic qualifications?

All participants must be between the ages of 18-40

c. State why the selection will be made on the basis of 2(b).

The American College of Sports Medicine (ACSM) in the, "Guidelines for Exercise Testing, 5th Edition", states that individuals in this age group may participate in vigorous physical activity without seeking medical clearance. This project will not be providing medical clearance for prospective participants; therefore, it would be prudent to select individuals in which this evaluation is not required for subsequent participation.

3. **Procedures:** What precisely will be done to the subjects? Explain in detail your methods and procedures in terms of what will be done to subjects. If you are using a questionnaire or handout, please include a copy within each set of application documents.

Orientation

An investigator will meet with the prospective participant to explain test procedures and methods utilized in this study. The participant will be provided with a written copy of the informed consent document, which further details this information. The participant will be asked to read and sign the informed consent document before s/he is allowed to take part in the investigation. A brief medical history form will be administered to participants and will be used to provide investigators with information on the participant's present and past health status. Additionally, the subjects will be given Keirsey Temperament Sorter II (KTS-II) and a CO_2 sensitivity test. Other physical attributes such as height, weight, age, sex, and overall physical condition will be noted. The participant will be asked to complete a Physical Activity Readiness Questionnaire (PAR-Q), which will be used to determine whether vigorous activity is appropriate for the individual at that particular time.

VO_2 max pre-testing

A maximal oxygen consumption test will be performed on all prospective participants using a Quinton motorized treadmill. Participants will be asked to warm-up and stretch for approximately 5-10 minutes prior to the start of the test. Participants will be equipped with a Hans Rudolph one-way breathing valve configured with a rubber adaptable mouthpiece. This apparatus will be interfaced with a standard Fleisch pneumotach and mass spectrometer to monitor continuous expired airflow. Heart rate measurements will be assessed using a standard ECG electrode configuration with the leads connected to a Hewlett Packard Monitoring System.

The initial work rate will be established at a speed and grade designed to elicit 70% of the participant's age-predicted maximal heart rate. The work rate will be adjusted every 3^{rd} minute until the participant either experiences volitional fatigue, fails to display a rise in oxygen consumption ($\geq$150 ml O_2) in accordance with the increase in work rate, or exhibits cardiovascular responses that contraindicate further assessment. This test will be completed in approximately 9-15 minutes.

80-85% VO_2 max testing

Four sessions will be conducted at 80-85% of the participant's maximal aerobic capacity using the Quinton motorized-treadmill. One session will utilize the Hans Rudolph one-way breathing valve configured with a rubber adaptable mouthpiece and attached to a Fleish pneumotach. In the other three sessions, the participant will don U.S. Army M17 full-facepiece respirator mask with inhalation modified to give resistance of 1.64, 3.32, 6.47 cm H_2O sec/L at a flow of 1.42 L/sec.

The participant will be asked to warm-up and stretch for approximately 5-10 minutes prior the start of the session. A respirator will be affixed to the participant and the treadmill speed and grade will be set at a work rate eliciting approximately 70 % of the individual's age-predicted maximal heart rate. This work rate will be slowly ramped to the speed and grade corresponding to 80-85% of the participant's maximal aerobic capacity. The participant will be asked to exercise at this intensity until he or she experiences volitional fatigue. These procedures will be used in all 4 conditions. Rating of Perceived Exertion (RPE) and Breathing Apparatus Comfort Scales (BACS) will be periodically used to objectively gage fatigued and comfort of the subject during each condition. Based on previous experience, each session should take a total of 1 hour which includes the 5-20 minute exercise.

CO_2 Sensititivity Testing

Because breath holding time may be an indirect indication of sensitivity to the build-up of carbon dioxide, each subject will be required to empty their lung and then take a deep breath and then hold as long as possible. This procedure will be repeated twice with 60-second breaks between the first and second attempts. In addition, each participant will place a 6 L breathing bag over his or her mouth and nose and breath into the bag until the subject stops at his or her discretion. The subject indicates his or her level of anxiety on a Visual Analog Scale (VAS) with "no anxiety at all" and "the worst anxiety ever" on a scale from 1-5 every thirty seconds.

Symptoms of anxiety will be assessed before and after the tests above. Profile of Mood States (POMS), and Speildberger State-Trait Inventory will be given pre and post CO_2 sensitivity test.

4. **Risks and Benefits:** Are there any risks to the subjects? If so, what are these risks? What potential benefits will accrue to justify taking these risks?

Risks

This investigation exposes participants to the potential risks that are associated with exercise. For example, vigorous exercise imposes stress on the cardiovascular system that could become life threatening in individuals with underlying cardiovascular disease. However, as the age range of participants in this study will be limited to the 18-40 year old range, this risk is reduced. The American College of Sports Medicine (ACSM) has identified adults within this age group as an appropriate reference sample for safely undertaking vigorous exercise.

Additional precautions that will be taken to reduce risk in this study include the administration of a brief medical history questionnaire that will be used to assess the participant's physiological compatibility with the study requirements. A Physical Activity Readiness Questionnaire (PAR-Q) will also be administered to subjects to determine whether vigorous exercise is appropriate at this juncture. These procedures will be employed to attenuate the risk of cardiovascular episodes in this investigation.

Test sessions will be conducted on a motorized treadmill, which at times will be set at a work rate (speed and grade) requiring the participant to run. In these instances, the potential for a participant to stumble or fall exists. Investigators will be stationed near the treadmill to assist participants if exposed to this potential risk. Further, participants will be informed verbally prior to adjustment of the treadmill speed and grade.

There are no known risks associated while wearing the respirator. Historically, claustrophobia may occur and the respirator will be removed immediately at the subject's discretion.

Benefits

The participants will not incur any monetary benefits as a result of taking part in this investigation. Test results will be provided to subjects once the project has been completed.

5. **Confidentiality**: Adequate provisions must be made to protect the privacy of subjects and to maintain confidentiality of identifiable information. Explain how your procedures accomplish this objective, including such information as the means of data storage, data location and duration, description of persons with access to the data and method of destroying the data when completed.

   Assigning the subject an identification number will preserve anonymity during data collection and analysis. Subjects will be referred by their numbers whenever any documentation is made of the data. Only those individuals directly involved in the collection or analysis of this data will be permitted access to this information.

6. **Information and Consent Forms:** State specifically what information will be provided to the subjects about the investigation. Is any of this information deceptive? State how the subjects' informed consent will be obtained. Include a formal draft of the consent form that you intend to utilize. Include a description of how data storage methods ensure confidentiality within the consent form.

   All subjects will meet with the assistant investigator and be given a copy of the informed consent document containing a written description of the test methods and procedures. A copy of the informed consent document has been attached to this protocol. None of the information provided to the subjects will be deceptive. Confidentiality will be further maintained by storing the data in the office of the assistant investigator.

7. **Conflict of Interest:** Describe the potential conflict of interest, including how such a conflict would affect the level of risk to the study participants.

No conflicts of interest are anticipated to arise, and therefore no increased risk will develop.

Spielberger –State-Trait Anxiety Inventory Trait

Form x-1

Directions: A number of statements which people have used to describe them selves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate **how you feel right now**, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

Scale 1. Not at all
2. Somewhat
3. Moderately so
4. Very much so

Questions:
1. I feel calm.
2. I feel secure.
3. I am tense.
4. I am regretful.
5. I feel at ease.
6. I feel upset.
7. I am presently worrying over possible misfortunes.
8. I feel rested.
9. I feel anxious.
10. I feel comfortable.
11. I feel self confident.
12. I feel nervous.
13. I am jittery.
14. I feel "high strung."
15. I am relaxed.
16. I feel content.
17. I am worried.
18. I feel over excited and "rattled."
19. I feel joyful.
20. I feel pleasant.

Spielberger –State-Trait Anxiety Inventory Trait

Form x-2

Directions: A number of statements which people have used to describe them selves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to **indicate how you generally feel**. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

Scale
1. Almost never
2. Sometimes
3. Often
4. Almost always

Questions:

21. I feel pleasant.
22. I tire quickly.
23. I feel like crying.
24. I wish I could be as happy as others seems to be.
25. I am losing out on things because I can't make up my mind soon enough.
26. I feel rested.
27. I am "calm, cool, and collected."
28. I feel that difficulties are pilling up so that I cannot overcome them.
29. I worry too much over something that really doesn't matter.
30. I am happy.
31. I am inclined to take things hard.
32. I lack self-confidence.
33. I feel secure.
34. I try to avoid facing a crisis or difficulty.
35. I feel blue.
36. I am content.
37. Some unimportant thought runs through my mind and bothers me.
38. I take disappointments so keenly that I can't put them out of my mind.
39. I am a steady person.
40. I get in a state of tension or turmoil as I think over my recent concerns and interests.

NAME ______________________ DATE ____________

SEX: Male (M) Female (F)

IDENTIFICATION

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

0 1 2 3 4 5 6 7 8 9

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases.

0 = Not at all
1 = A little
2 = Moderately
3 = Quite a bit
4 = Extremely

Col (C) O.P. (O)

	NOT AT ALL	A LITTLE	MODERATELY	QUITE A BIT	EXTREMELY
1. Friendly	0	1	2	3	4
2. Tense	0	1	2	3	4
3. Angry	0	1	2	3	4
4. Worn out	0	1	2	3	4
5. Unhappy	0	1	2	3	4
6. Clear-headed	0	1	2	3	4
7. Lively	0	1	2	3	4
8. Confused	0	1	2	3	4
9. Sorry for things done	0	1	2	3	4
10. Shaky	0	1	2	3	4
11. Listless	0	1	2	3	4
12. Peeved	0	1	2	3	4
13. Considerate	0	1	2	3	4
14. Sad	0	1	2	3	4
15. Active	0	1	2	3	4
16. On edge	0	1	2	3	4
17. Grouchy	0	1	2	3	4
18. Blue	0	1	2	3	4
19. Energetic	0	1	2	3	4
20. Panicky	0	1	2	3	4
21. Hopeless	0	1	2	3	4
22. Relaxed	0	1	2	3	4
23. Unworthy	0	1	2	3	4
24. Spiteful	0	1	2	3	4
25. Sympathetic	0	1	2	3	4
26. Uneasy	0	1	2	3	4
27. Restless	0	1	2	3	4
28. Unable to concentrate	0	1	2	3	4
29. Fatigued	0	1	2	3	4
30. Helpful	0	1	2	3	4
31. Annoyed	0	1	2	3	4
32. Discouraged	0	1	2	3	4
33. Resentful	0	1	2	3	4
34. Nervous	0	1	2	3	4
35. Lonely	0	1	2	3	4
36. Miserable	0	1	2	3	4
37. Muddled	0	1	2	3	4
38. Cheerful	0	1	2	3	4
39. Bitter	0	1	2	3	4
40. Exhausted	0	1	2	3	4
41. Anxious	0	1	2	3	4
42. Ready to fight	0	1	2	3	4
43. Good natured	0	1	2	3	4
44. Gloomy	0	1	2	3	4
45. Desperate	0	1	2	3	4
46. Sluggish	0	1	2	3	4
47. Rebellious	0	1	2	3	4
48. Helpless	0	1	2	3	4
49. Weary	0	1	2	3	4
50. Bewildered	0	1	2	3	4
51. Alert	0	1	2	3	4
52. Deceived	0	1	2	3	4
53. Furious	0	1	2	3	4
54. Efficient	0	1	2	3	4
55. Trusting	0	1	2	3	4
56. Full of pep	0	1	2	3	4
57. Bad-tempered	0	1	2	3	4
58. Worthless	0	1	2	3	4
59. Forgetful	0	1	2	3	4
60. Carefree	0	1	2	3	4
61. Terrified	0	1	2	3	4
62. Guilty	0	1	2	3	4
63. Vigorous	0	1	2	3	4
64. Uncertain about things	0	1	2	3	4
65. Bushed	0	1	2	3	4

MAKE SURE YOU HAVE ANSWERED EVERY ITEM.

POM 021

Physical Activity Readiness Questionnaire - PAR-Q (revised 1994)

PAR - Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	Has you doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
☐	☐	2.	Do you feel pain in your chest when you do physical activity?
☐	☐	3.	In the past month, have you had chest pain when you were not doing physical activity?
☐	☐	4.	Do you lose your balance because of dizziness or do you ever lose consciousness?
☐	☐	5.	Do you have a bone or joint problem that could be made worse by a change in your physical activity?
☐	☐	6.	Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
☐	☐	7.	Do you know of any other reason why you should not do physical activity?

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want—as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active—begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal—this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever—wait until you feel better; or
- if you are or may be pregnant—talk to your doctor before you start becoming more active.

Please note: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

You are encouraged to copy the PAR-Q but only if you use the entire form

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

NAME ______________________

SIGNATURE ______________________ DATE ______________________

SIGNATURE OF PARENT ______________________ WITNESS ______________________
or GUARDIAN (for participants under the age of majority)

Supported by:

Medical History Questionnaire
(Cycle Study)

Name______________________________ Date_____________

Address____

____

Phone# (day)__________________ (night)_______________________

Age________ Date of Birth____________ Gender__________

Height___________ Weight___________ Race____________

Family History

List all *deceased* immediate family members (parents, grandparents, and brothers/sisters) as well as cause of death and age at death.

____

____

____

____

____

Medications

List any current medications or dietary supplements you may be taking and the reason:

____

____

____

____

Allergies (include allergies to medications as well):

____

____

____

1

Personal Health Conditions:

Have you had any of the following? Please circle the appropriate response:

High blood pressure	yes	no
Heart murmur	yes	no
Heart attack	yes	no
Stroke	yes	no
Diseases of the arteries	yes	no
Angina	yes	no
Rheumatic fever, scarlet fever	yes	no
Thyroid Disease	yes	no
Emphysema	yes	no
Diabetes	yes	no
Bronchitis, pneumonia	yes	no
Yellow jaundice	yes	no
Hepatitis	yes	no
Kidney disease	yes	no
Depression	yes	no
Arthritis	yes	no
Tuberculosis	yes	no
Epilepsy	yes	no
Asthma	yes	no
Leukemia	yes	no
Cancer	yes	no
Glaucoma	yes	no
Elevated cholesterol	yes	no
Polio	yes	no
Diphtheria	yes	no

Have you ever experienced any of the following? Please circle appropriate response:

Frequent headaches	yes	no
Frequent colds	yes	no
Nose-bleeds	yes	no
Recurrent sore throats	yes	no
Wheezing spells	yes	no
Coughed up blood	yes	no
Coughed up phlegm	yes	no
Hearst palpitations	yes	no
Chest pain w/exercise	yes	no
Dizzy spells	yes	no
Shortness of breath	yes	no
Swollen feet/ankles	yes	no

Heartburn or intestinal problems	yes	no
Pain or cramps in legs	yes	no
Painful joints	yes	no
Ulcers	yes	no
Recurrent constipation	yes	no
Recurrent diarrhea	yes	no
Prostrate trouble	yes	no
Kidney problems	yes	no
Phlebitis	yes	no
Varicose veins	yes	no
Osteoporosis	yes	no

Smoking Check the appropriate response below:

Never smoked______ stopped more than 10 years ago___________
Smoke up to 1 pack/day___________ smoke 1-2 pack/day________
3+ pack/day________

What type of smoking? (circle all that apply) cigarette cigar pipe

Alcohol

How many alcoholic beverages per week do you consume? (circle one)

None up to 2/week 3-7/week 7-10/week 10+/week

What type of alcohol do you drink? ________________________________

Exercise

If you participate in a regular aerobic exercise program such as jogging or soccer, please indicate the frequency and type of exercise below. Regular means 3 or more times/week.

Circle one of the following:
< once/week (circle if yes) yes

1-3 times/week (circle one) yes no
type:________________________________

4-5 times/week (circle one) yes no
type:________________________________

6-7 times/week (circle one) yes no
type:________________________________

Date of Last Complete Physical Exam:____________________

Normal:__________ Abnormal;____________________

Date of Last Eye Exam:______________

Normal:__________ Abnormal:______________

Date of Last Chest X-ray:__________________

Normal:__________ Abnormal:________

Date of Last Electrocardiogram:__________________

Normal:________________ Abnormal:______________

Date of Most Recent Blood Lipid Analysis:___________________________

Report values below if known:

Total Blood Cholesterol__________ Triglycerides____________

HDL Cholesterol________________ LDL Cholesterol__________

Most Recent Hospitalization and Reason:_________________________________

____

____

Date and Amount of Last Blood Donation:___________________________________

____

<u>For Women Only</u> (Circle appropriate responses)

Are you currently pregnant? yes no

Are you currently menstruating? yes no

If yes, are your menstrual cycles regular (once per month)? yes no

4

Health Insurance

I do have health insurance (circle one) yes no

If yes, my insurance organization is:______________________________

I do have dental coverage (circle one) yes no

Do Not Write Below This Line:
Total Number of Cardiovascular Risk Factors:______________________

The *Please Understand Me* Phenomenon

Keirsey and Bates's *Please Understand Me,* first published in 1978, sold nearly 2 million copies in its first 20 years, becoming a perennial best seller all over the world. Advertised only by word of mouth, the book became a favorite training and counseling guide in many institutions—government, church, business—and colleges across the nation adopted it as an auxiliary text in a dozen different departments. Why?

Perhaps it was the user-friendly way that *Please Understand Me* helped people find their personality style. Perhaps it was the simple accuracy of Keirsey's portraits of temperament and character types. Or perhaps it was the book's essential message: that members of families and institutions are OK, even though they are fundamentally different from each other, and that they would all do well to appreciate their differences and give up trying to change others into copies of themselves.

Now: *Please Understand Me II*

For the past twenty years Dr. Keirsey has continued to investigate personality differences—to refine his theory of the four temperaments and to define the facets of character that distinguish one from another. His findings form the basis of *Please Understand Me II,* an updated and greatly expanded edition of the book, far more comprehensive and coherent than the original, and yet with much of the same easy accessibility.

One major addition is Keirsey's view of how the temperaments differ in the intelligent roles they are most likely to develop. Each of us, he says, has four kinds of intelligence—tactical, logistical, diplomatic, strategic—though one of the four interests us far more than the others, and thus gets far more practice than the rest. Like four suits in a hand of cards, we each have a long suit and a short suit in what interests us and what we do well, and fortunate indeed are those whose work matches their skills.

As in the original book, *Please Understand Me II* begins with Keirsey's Temperament Sorter, the most used personality inventory in the world. But also included is *The Keirsey FourTypes Sorter,* a new short questionnaire that identifies one's basic temperament and then ranks one's second, third, and fourth choices. Share this new questionnaire with friends and family, and get set for a lively and fascinating discussion of personal styles.

—Dr. Stephen Montgomery, editor

The Keirsey Temperament Sorter II

Reprinted from

Please Understand Me II

The Keirsey Temperament Sorter II

Check either (a) or (b) answers and transfer check marks to scoring form when finished.

1 When the phone rings do you
__(a) hurry to get to it first
__(b) hope someone else will answer

2 Are you more
__(a) observant than introspective
__(b) introspective than observant

3 Is it worse to
__(a) have your head in the clouds
__(b) be in a rut

4 With people are you usually more
__(a) firm than gentle
__(b) gentle than firm

5 Are you more comfortable in making
__(a) critical judgments
__(b) value judgments

6 Is clutter in the workplace something you
__(a) take time to straighten up
__(b) tolerate pretty well

7 Is it your way to
__(a) make up your mind quickly
__(b) pick and choose at some length

8 Waiting in line, do you often
__(a) chat with the others
__(b) stick to business

9 Are you more
__(a) sensible than ideational
__(b) ideational than sensible

10 Are you more interested in
__(a) what is actual __(b) what is possible

11 In making decisions do you go more by
__(a) data __(b) desires

12 In sizing up others do you tend to be
__(a) objective and impersonal
__(b) friendly and personal

13 Do you prefer contracts to be
__(a) signed, sealed, and delivered
__(b) settled on a handshake

14 Are you more satisfied having
__(a) a finished product
__(b) work in progress

15 At a party, do you
__(a) interact with many, even strangers
__(b) interact with a few friends

16 Do you tend to be more
__(a) factual than speculative
__(b) speculative than factual

17 Do you like writers who
__(a) say what they mean
__(b) use metaphors and symbolism

18 Which appeals to you more:
__(a) consistency of thought
__(b) harmonious relationships

19 In disappointing someone are you
__(a) frank and straightforward
__(b) warm and considerate

20 On the job do you want your activities
__(a) scheduled
__(b) unscheduled

21 Do you more often prefer
__(a) final, unalterable statements
__(b) tentative, preliminary statements

22 Does interacting with strangers
__(a) energize you
__(b) tax your reserves

23 Facts are more likely to
__(a) speak for themselves
__(b) illustrate principles

24 Do you find visionaries and theorists
__(a) somewhat annoying
__(b) rather fascinating

25 In a heated discussion, do you
__(a) stick to your guns
__(b) look for common ground

26 Is it better to be
__(a) just
__(b) merciful

27 At work, is it more natural for you to
__(a) point out mistakes __(b) try to please

28 Are you more comfortable
__(a) after a decision __(b) before a decision

29 Do you tend to
__(a) say right out what's on your mind
__(b) keep your ears open

30 Common sense is
__(a) usually reliable
__(b) frequently questionable

31 Children often do not
__(a) make themselves useful enough
__(b) exercise their fantasy enough

32 When in charge of others are you
__(a) firm and unbending
__(b) forgiving and lenient

33 Are you more often
__(a) a cool-headed person
__(b) a warm-hearted person

34 Are you prone to
__(a) nailing things down
__(b) exploring the possibilities

35 In most situations are you more
__(a) deliberate
__(b) spontaneous

36 Do you think of yourself as
__(a) outgoing __(b) private

37 Are you more frequently
__(a) a practical sort of person
__(b) a fanciful sort of person

38 Do you speak more in
__(a) particulars than generalities
__(b) generalities than particulars

39 Which is more of a compliment:
__(a) "There's a logical person"
__(b) "There's a sentimental person"

40 Which rules you more
__(a) your thoughts
__(b) your feelings

41 When finishing a job, do you like to
__(a) tie up all the loose ends
__(b) move on to something else

42 Do you prefer to work
__(a) to deadlines
__(b) just whenever

43 Are you the kind of person who
__(a) is rather talkative
__(b) doesn't miss much

44 Are you inclined to take what is said
__(a) more literally
__(b) more figuratively

45 Do you more often see
__(a) what's right in front of you
__(b) what can only be imagined

46 Is it worse to be
__(a) a softy __(b) hard-nosed

47 In hard circumstances are you sometimes
__(a) too unsympathetic
__(b) too sympathetic

48 Do you tend to choose
__(a) rather carefully
__(b) somewhat impulsively

49 Are you inclined to be more
__(a) hurried than leisurely
__(b) leisurely than hurried

50 At work do you tend to
__(a) be sociable with your colleagues
__(b) keep more to yourself

51 Are you more likely to trust
__(a) your experiences
__(b) your conceptions

52 Are you more inclined to feel
__(a) down to earth
__(b) somewhat removed

53 Do you think of yourself as a
__(a) tough-minded person
__(b) tender-hearted person

54 Do you value more in yourself being
__(a) reasonable __(b) devoted

55 Do you usually want things
__(a) settled and decided
__(b) just penciled in

56 Would you say you are more
__(a) serious and determined
__(b) easy going

57 Do you consider yourself
__(a) a good conversationalist
__(b) a good listener

58 Do you prize in yourself
__(a) a strong hold on reality
__(b) a vivid imagination

59 Are you drawn more to
__(a) fundamentals
__(b) overtones

60 Which seems the greater fault:
__(a) to be too compassionate
__(b) to be too dispassionate

61 Are you swayed more by
__(a) convincing evidence
__(b) a touching appeal

62 Do you feel better about
__(a) coming to closure
__(b) keeping your options open

63 Is it preferable mostly to
__(a) make sure things are arranged
__(b) just let things happen naturally

64 Are you inclined to be
__(a) easy to approach __(b) reserved

65 In stories do you prefer
__(a) action and adventure
__(b) fantasy and heroism

66 Is it easier for you to
__(a) put others to good use
__(b) identify with others

67 Which do you wish more for yourself
__(a) strength of will
__(b) strength of emotion

68 Do you see yourself as basically
__(a) thick-skinned
__(b) thin-skinned

69 Do you tend to notice
__(a) disorderliness
__(b) opportunities for change

70 Are you more
__(a) routinized than whimsical
__(b) whimsical than routinized

Directions for Scoring

1. Add down so that the total number of **a** answers is written in the box at the bottom of each column (see above for illustration). Do the same for the **b** answers you have checked. Each of the 14 boxes should have a number in it.

2. Transfer the number in box No. 1 of the answer grid to box No. 1 below the answer grid. Do this for box No. 2 as well. Note, however, that you have two numbers for boxes 3 through 8. Bring down the first number for each box beneath the second, as indicated by the arrows. Now add all the pairs of numbers and enter the total in the boxes below the answer grid, so each box has only one number.

3. Now you have four pairs of numbers. Circle the letter below the larger numbers of each pair (see sample answer sheet above for illustration). If the two numbers of any pair are equal, then circle neither, but put a large X below them and circle it.

The 16 Combinations

You have now identified your personality type. It should be one of the following:

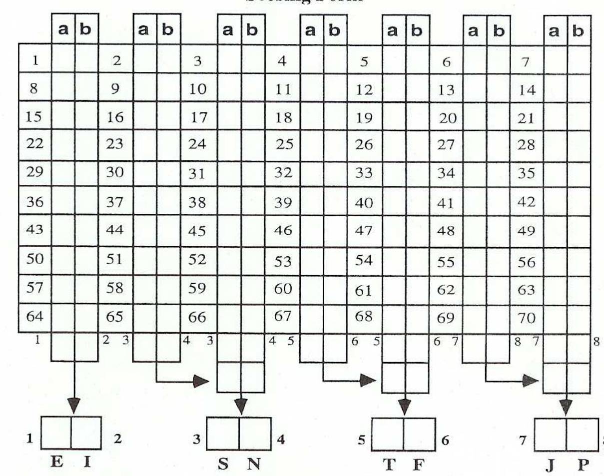
SP Artisan	SJ Guardian	NF Idealist	NT Rational
ESTP	ESTJ	ENFJ	ENTJ
ISTP	ISTJ	INFJ	INTJ
ESFP	ESFJ	ENFP	ENTP
ISFP	ISFJ	INFP	INTP

If you have an X in your type label, you should read the two portraits indicated, and choose the one more like you. For example, if your type label was **ESXJ**, then reading both the **ESTJ** and **ESFJ** portraits may help you choose one or the other as more like you. Or perhaps your type label was **XNFP**. Here, again, reading both the **INFP** and **ENFP** portraits may help you decide which type seems more like you.

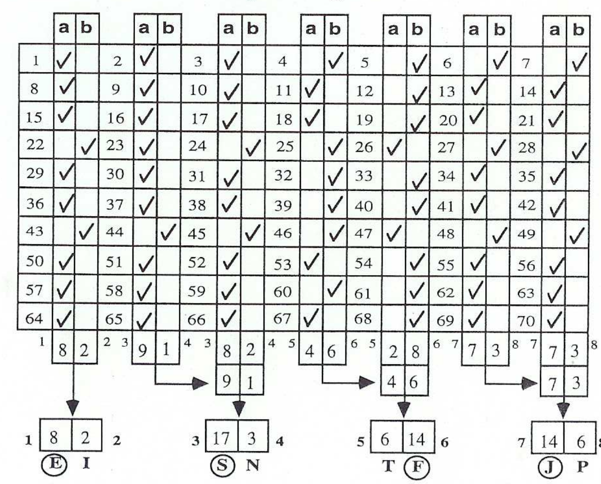
About the Validity of Personality Questionnaires

Personality questionnaires are not measuring devices like rulers, meters, or scales that measure such things as weight, height, or speed. So they cannot be validated the way measuring devices are. This does not mean, however, that the results of personality questionnaires cannot be checked out for their accuracy. They can be, if those completing the questionnaires are willing to ask others who know them to watch what they say and do, keeping in mind the portrait of personality the questionnaire indicated. This is called "type-watching," an enlightening and enjoyable habit acquired by many who have completed the Temperament Sorter II, and who have read *Please Understand Me II*. By type-watching in the light of a theory of personality, we not only come to understand ourselves, but gradually come to understand, and appreciate, our spouse, our children, our parents, our friends, and our colleagues. Many covet this habit once they have acquired it, and many pursue it with growing interest and satisfaction.

Scoring Form



Sample Scoring Form



Prometheus Nemesis Book Company
Order Form

Qty $0.00

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Seeking Volunteers for Mask Wear Research Project

Volunteers between the ages of 18 and 39 years old are needed to participate in a research project being conducted in the Biological Resources Engineering Department under the direction of Dr. Art Johnson.

Volunteers will perform 3 test conditions of treadmill exercise while wearing a military gas mask. There will be one additional VO_2 max test to determine your cardiovascular capacity. The gas mask will be altered to have different levels of breathing resistance. We will be studying how these different levels affect your exercise performance. All test sessions associated with this study will be completed in about one hour on 4 different days. If you are interested in participating in this study, or would like to know more about it before you make your decision to volunteer, please call William Scott or Frank Koh at 301-405-1186.

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