

# PREDICTION OF WORK TOLERANCE TIME USING PSYCHOLOGICAL ASSESSMENT TESTS

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## INTRODUCTION

The ability to predict an individual's work tolerance time (WTT) is a topic of great interest to researchers in many fields. This study was performed to see if it was possible to predict, using standard psychological tests, WTT on a treadmill for subjects exercising in chemical protective clothing (CPC) or standard UK military combat clothing (control, C). The CPC comprised a two piece garment worn over combat clothing, a respirator, and protective rubber overboots and gloves.

Spielberger's State-Trait Anxiety Inventory (STAI) (1) has been used as a tool by Morgan and Raven (2) for predicting respiratory distress in subjects exercising while wearing industrial respirators. It has been suggested that individuals who have high trait anxiety scores are more likely to experience respiratory distress and other performance lowering effects while performing hard physical work in CPC than individuals who score in the normal range for this trait.

Morgan (3) proposed that the personality factor of neuroticism (N) is closely related to the inherited degree of lability of the autonomic nervous system; while the extraversion (E) factor is closely related to the degree of excitation and inhibition present in the central nervous system. In this work, the STAI and Eysenck Personality Inventory (EPI) (4), were assessed to find out if they could be used to predict WTT or the decrease in performance caused by wearing CPC. The STAI gives ratings of normal daily anxiety levels, the EPI gives rating of levels of N and E and has a built-in lie scale.

## METHODS

Eighteen male subjects (mean  $\pm$ SD, age 29.7  $\pm$ 4.0 yrs, height 1.77  $\pm$ 0.06 m, weight 79.2  $\pm$ 6.4 kg) participated in this study which had been approved by an independent ethics committee. Each person twice performed a modified Balke-Ware (5) exercise test on a treadmill, walking for as long as they were able or until they had completed 28 minutes, whichever occurred first. The tests were

performed on **two** separate days separated by a minimum of 24 hours. The treadmill maximum gradient was 22% and subjects who reached this gradient continued at the same slope until completing 28 minutes. ~~Half~~ of the participants wore CPC for their first test and the remainder wore C. Exercise tests were carried out at an ambient temperature of 21° C *dry* bulb, with a relative humidity of 50%.

Before performing the exercise tests subjects completed the STAI and one of the two EPI forms, the second EPI form ~~was~~ completed after the second treadmill walk. The STAI form presents lists of statements to be rated by subjects according to how well they described their current feelings. The inventory differentiates "state" or feeling at the moment, **from** "trait" or feelings generally. The EPI questionnaire measures two of the main personality dimensions; the factors of extraversion/introversion and neuroticism/stability. It is available **as two** matched forms, Form A and Form B each containing 57 questions. Half the subjects who wore CPC for their first treadmill test completed Form A before starting the test, with the remaining half completing Form B. At the end of the second exercise test each subject filled in the complementary form. None of the forms were scored until the exercise tests were complete.

**Test Scoring** The STAI had a total of 40 statements on each questionnaire, 20 statements each with four possible responses made up form Y-1 which indicated the subject's state; on the reverse of the page a further 20 statements, again each with 4 possible responses, made up form Y-2 which indicated the subject's trait. Each STAI response option had a weighted score of 1 to 4. To obtain scores for the S-anxiety and T-anxiety scales the weighted scores were added for the twenty items that made up each scale. The combined scores for each scale can vary from a minimum of 20 to a maximum of 80. Normal values for the scales were taken from those published in the test manual (1). The EPI had a total of 57 questions on each form. The maximum possible score for E and N was 48 each for the two parts of the form combined, the remaining questions gave a lie rating for the scale. The normal standardisation scores (3) for the EPI have a subgroup of results for military subjects, these standards were used for analysis of this work.

Relationships between the total WTT (ie endurance time) and the STAI or EPI scores were investigated using Pearson Correlation analysis. Data are presented **as** mean ( $\pm$ SD) and Pearson product moment correlation, *r* with level of probability, *p*; statistical significance was accepted at  $p < 0.05$ .

## RESULTS

The participating subjects had low scores for both state and trait anxiety, these were significantly below the mean values published by Spielberger, suggesting that the testing was not perceived as stressful. Measured scores were state  $24.7(\pm 4.1)$ , trait  $28.1(\pm 7.1)$ ; Spielberger mean values are state  $35.72(k10.4)$  and trait  $34.89(\pm 9.19)$ . The scores for the EPI showed that the group had low scores for N and above average scores for ratings of E. In this work the score for N was  $16.6(\pm 7.1)$ , for E  $32.1(k7.0)$ . Eysenck mean values are N  $20.8(\pm 9.2)$ , E  $27.9(k7.2)$ .

There was no statistically significant relationship between WTT in C or CPC and the state or trait scores from the STAI, nor was there any relationship between the WTTs and the score for N from the EPI. However, there was a relationship between E from the EPI and the WTT in both C and CPC ( $r = -0.6, p = 0.009$  for C and  $r = -0.6, p = 0.008$  for CPC). Taking the time difference between WTT in each clothing condition and regressing it against the E scores, indicated that there was a trend for the E score to be predictive of the time difference, but that this trend was not statistically significant ( $r = -0.4, p = 0.09$ ).

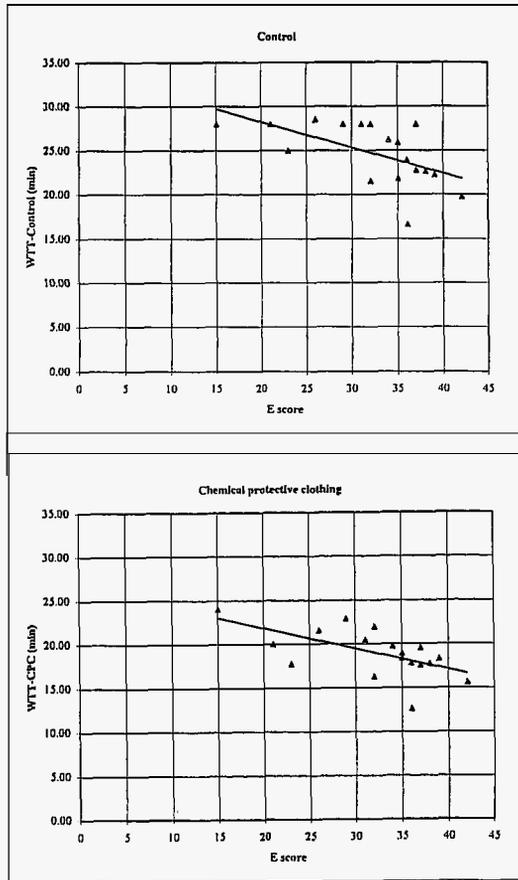
## CONCLUSIONS

This study did not show any relationship between state and trait anxiety levels, or level of neuroticism, and the ability to perform the steadily increasing level of work in the graded exercise test. While the STAI has previously been used successfully to predict reduced work performance caused by respiratory distress (2) it does not have any ability to predict WTT in this exercise test.

The relationship between WTT and E in this work shows that those with the highest E scores had shorter working times in both C and CPC. This does not agree with Morgan (3) who states that extraverted subjects perceive the same intensity of exercise to be less strenuous than introverted subjects; but only at higher work loads. He suggests that the influence of personality would be greatest where discomfort or pain is encountered during work. The results of this work do not fit in with Morgan's theory; an alternative is that the more introverted subjects were able to "turn in on themselves" and thus ignore any discomfort and work for longer.

This study has shown that under these specific exercise conditions the extraversion personality score in the Eysenck Personality Inventory can be related to work tolerance times in combat or chemical protective clothing. Further investigation is required to assess if this relationship holds for different work rates and exercise modes.

Graphs of WIT-C and WTT-CPC vs STAI scores



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