THE PSYCHOLOGICAL SYMPTOMS AND THE PHYSIOLOGICAL RESPONSE TO EXERCISE OF REPATRIATED PRISONERS OF WAR WITH NEUROSIS

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Introduction

The object of this paper is twofold: first, to describe and analyse the symptoms of repatriated prisoners of war who were sent to a neurosis centre for rehabilitation; and second, to report some physiological measurements of these men's response to moderate exercise. These patients are of peculiar interest, in that they represent what might be called a "semi-neurotic" population, of men who have not the degree of predisposition of the usual civilian psychoneurotic, but who have developed mild neurotic symptoms under considerable environmental stress. A general description of their characteristics and of their treatment and its results has been given in the paper at p. 53 of this issue.

The first part of the present paper reports an attempt to quantitate the severity of the various symptoms complained of, and from an analysis of this data to arrive at some classification of this sort of neurosis in symptomatological terms which are at least less arbitrary and less objectionable from the point of view of method than those in current use. It is commonplace that different psychiatrists may on occasion diagnose the same neurotic patient quite differently; one as "reactive depression," another as "anxiety state," a third as "effort syndrome." This happens when a patient has symptoms suggestive of all three of these diagnoses, thus making it impossible for a valid appraisal in one descriptive category only to be arrived at. Believing that such a patient—and indeed, all others—should be classified on a rating of severity in each of several such descriptive categories, we have endeavoured to discover what categories would be most suitable. This part of our study should be regarded as a tentative and pilot one only; but we believe that interesting results might

be obtained by applying this method to more classical cases of neurosis, by spending more time on detailed symptom study, and, primarily and of most importance, by studying further the pathological physiology of such patients.

One aspect of this pathological physiology is the response to exercise, and the second part of our study reports measurements on these prisoner-of-war patients similar to those previously made by one of us on the more usual cases of neurosis (Jones and Mellersh, 1946 a, b).

Material

The material consisted of 100 soldiers, who were a sample, selected by taking every fifth admission, of the patients at the ex-prisoner-of-war neurosis unit (excluding the very occasional mental defective and psychotic). They were examined during the period June to September, 1945. These men had all been prisoners of war in Germany for varying lengths of time, and on repatriation, or return to their unit after their repatriation leave, had shown signs of psychological maladjustment. Specifically, they constituted the most maladjusted 1 per cent. of all prisoners of war returned from north-west Europe. Nevertheless, as we have indicated, they cannot be classed as psychoneurotic in the usual sense, as applied to civilian patients. They are far less constitutionally predisposed to neurosis than the usual patient, and clinically, physiologically, and psychologically appear to lie between the normal and the "true" neurotic. The mean age of the 100 was 27.3 years, with a standard deviation of 4.0 years. Excluding eight old soldiers, the average time of army service was five and a half years with a S.D. of one year. An average of four years had been spent overseas, and three and a half years as prisoners of war.

Psychological Symptoms

Methods.—Fifty of these patients were seen by investigator J, and fifty by investigator T. Throughout this section these two groups will be considered separately. Difference in results for the two groups spring mainly from the investigators, for no significant differences exist between the subjects in age, time of service and of imprisonment, physique, oxygen consumption following a standard exercise, and other physiological tests. Despite an alternating method of selection, however, J's subjects were more intelligent than T's, both by progressive matrices test ($P < 0.01$) and Mill Hill Vocabulary ($P = 0.06$). In this regard, T's subjects are similar to normal conscripts as reported by Eysenck (1947), while J's are superior to them.

In an interview, lasting usually from two to two and a half hours, a detailed history was taken following the usual practice for neurotic patients, but using a stereotyped case form. Inquiry was made about the 64 symptoms shown in Table I, and an attempt was made to obtain more information than simply absence or presence of a particular symptom. The apparent severity of each symptom was rated on a seven-point, equal-appearing interval scale, 1 representing absence, 2 minimal severity, 7 maximal severity. Finally, when the history was completed, the investigator made his diagnostic summing-up of the case in a similar manner. Since we considered that neurotic patients without hysteria could not be satisfactorily separated into a dichotomy of reactive depressions and anxiety states, but could show symptoms of each at the same time, we made ratings under the three headings: (A) somatic anxiety (anxiety with somatic symptoms predominating); (B) psychic anxiety (left loosely defined, for later examination, but representing roughly anxiety without somatic response); and (C) depression. Ratings were also made under headings of hysteria, conversion, dysmnestic and dramatization, psychopathic character, paranoid symptoms, schizophrenic symptoms, and hypomanic symptoms. These latter ratings are not reproduced since they assumed no importance; their average figures were all under 1.4, and we had no individuals whose clinical diagnosis was hysteria or psychosis.

Some symptoms lend themselves readily to ratings of this sort; others do not. Sweating, palpitation, and effort intolerance, for example, can be readily, if roughly, quantitated; such symptoms as feeling "U.K. morals worse" cannot: Most of the symptoms, such as asocial, lack of confidence, or short-tempered, lie between these extremes. Careful inquiry into the details of a symptom, however, usually leads to some considerable basis for judgments of this sort; the rater of asocial, for instance, inquires precisely what stimulus was necessary to get the patient to meet strangers, friends, and close relatives over the last two months. In general both intensity and duration of a symptom were taken into account, more weight being given to the former.

Table I shows the average ratings made by each investigator. In general, there is very good agreement between J and T as to which symptoms were the most marked in these patients; the ratings were made entirely independently, and, after initially discussing the

TABLE I

AVERAGE RATINGS OF SYMPTOMS BY J AND T: 50 PATIENTS EACH

	J	T
Somatic anxiety	2.84 σ 1.2	3.14 σ 1.4
Psychic anxiety	3.26 0.9	3.40 1.2
Depression	2.62 1.0	2.64 1.4
<i>I. Symptoms with average rating above 2.50 by both J and T</i>		
Lack concentration	3.5	3.7
Depressed	3.0	3.3
Asocial	2.8	3.7
Don't belong	2.9	3.4
Shy females	2.7	3.3
Resentful army	2.8	3.2
Effort intolerance	3.3	2.6
Lack confidence	2.6	3.4
Trembling	3.0	2.6
Anxious expectation	2.6	2.9
Short tempered	2.7	3.0
Sweating	*	2.9

* Not rated by J.

<i>II. Rating above 2.0 by both J and T</i>		
Breathlessness	3.2	2.5
Fatigue	3.1	2.5
U.K. morals worse	2.8	2.5
Cooped up	2.5	2.7
Less sex desire	2.3	3.2
Anorexia	2.3	2.8
Palpitation	2.9	2.1
<i>III. Rating above 1.5 by both or above 2.0 by one</i>		
Dizziness	2.3	2.0
Throbbing headache	2.2	1.8
Fear fail civil life	2.0	2.7
Insomnia	1.9	2.9
Effort phobia	1.7	2.4
Pressure headache	1.5	2.9
Hypochondriacal	1.4	2.5
Nausea	1.5	2.4
Hot flushes	1.7	1.6
Chest constriction	1.6	1.6
Dry mouth	2.1	1.2
Guilt feeling	1.3	2.2
Nightmares	1.4	2.1

Other symptoms rated

Throbbings in neck, syncope, hyperventilation, tetany, stammering, abdominal cramps, frequency, enuresis, left chest pain, vomiting, flatulence, diarrhoea, fear of impotence, impotence, fear of sterility, family's affection less, patient's affection less, phobias, P.O.W. dreams, battle dreams, weeping, suicidal ideas, suicidal intentions, depersonalization, paranoid, obsessive-compulsive, sensation plus, sensation minus, motor weakness, dysmnestic, hysterical fits, resent civil population.

FIGURE—Distributions of ratings for traits analysed.

definition of symptoms, the two investigators did not at any time compare notes or discuss cases, formally or informally. Thus a comparison of the two series of results is a measure of the reliability of the ratings, akin to that obtained by the split-halves or odds-and-evens methods. The chief symptoms can be seen from the Table, and also those which these patients were usually lacking. It is with the commoner symptoms that nearly all the remainder of this section is concerned; the ratings of these were all intercorrelated for each observer, and the resulting matrices factor-analysed.*

The criterion for including symptoms in this analysis was, for T, those symptoms in which less than 20 men rated 1. These comprise all of groups I and II (Table I), except for less sex desire and palpitation, and include also insomnia, headache, and hypochondriacal of group III. The intercorrelated symptoms of J are the same, with inclusion of palpitation and U.K. morals worse and the omission of headache, hypochondriacal, and sweating. These are likewise symptoms in which fewer than 20 men rated 1, with the 3 exceptions of anorexia, U.K. morals worse, and insomnia. Somatic anxiety, psychic anxiety, and depression, the diagnostic traits, were included in each analysis.

In the Figure the distribution of these symptom ratings for each investigator is shown. Most of the distributions are of single-humped type, apart from the 1 ratings, though some of the less severe and less frequent ones, shown towards the bottom of the figure, begin to approach the J-shaped curve of the really rare trait. T tended to spread his ratings somewhat more than did J, but in general the distributions of the two investigators are fairly similar. As might be expected, the reliability of the commoner traits is somewhat greater than that of the rarer ones; the ranks correlation coefficient between the two distributions ranges from 0.46 to 0.95, with the average for the top nine traits in the figure being 0.84, and for the remainder 0.76. The average for the entire group of traits included in the factor analyses is 0.79, which seems reasonably satisfactory.

Thirty-four of the intercorrelations, chosen at random, were plotted out, and no marked curvilinearity of regression was visible to the eye. Within the broad limits of our accuracy, then, the product-moment coefficient can be taken to represent the degree of association between pairs of symptoms—with one reservation. We are disturbed by the piling up of 1 ratings. In very many cases, the single-humped curve is ranged between 2 and 7, simply because these ratings represent degrees of intensity of a symptom which is *present*. The rating 1 represents *absence*. There is a gap between the ratings 1 and 2 which is not subject to the same scale operation as the intervals of 2 to 3, 3 to 4,

and so on. It may be—and this we had in mind in devising the scales—that the rating 1, in palpitation say, really represents the entire scale of unusual heart action from average function to the point where the subject is conscious of palpitation. It might be said that a threshold exists between ratings 1 and 2, and that the trait we are really trying to measure continues to fall in several steps to the left of rating 2; our methods do not enable us to distinguish these steps, and consequently our 1 ratings appear to be excessive in number. With some of the more physiologically-based symptoms this seems a reasonable view to take, but we would be hard put to it to say what precisely such subclinical resentfulness towards army represents. However, since we see no simple way of getting around this difficulty without losing some of our information, we must remain content to draw attention to it. It seems unlikely to have appreciably affected the results of our factor analysis, since the symptoms which show most markedly this bimodality share no position in common in our result.

The two correlation matrices are not reproduced here. The $P=0.05$ level of significance can be assessed only for the null hypothesis for data not known to be drawn from a population distributed normally, the standard error of r when the true correlation is zero being given by

$$\frac{1}{\sqrt{N-1}}.$$

For fifty subjects a correlation of over 0.2 will be considered significant, and the number of correlations greater than this was 47 out of 253 for T and 73 out of 231 for J. There were no negative correlations significantly greater than zero. The coefficients were calculated by the product-moment method, without grouping. The matrices were then factor-analysed by both bipolar and group factor methods of Burt (1940); the figures in the leading diagonal were determined by an iterative procedure, and simple rather than weighted summation was used.

Results

ANALYSIS OF SYMPTOMS.—The factor analysis solution is shown in Tables II and III. A general and a bipolar (2 group) factor emerge for both investigators, and a small second bipolar factor for T.† About 40 per cent. of the total variance is accounted for by these factors. The general factor is given more prominence by J than by T, and, to a lesser extent, the reverse is true of the first bipolar factor. This general factor has its highest saturations with lack of concentration, shy of females, fatigue, less sex desire, anxious expectation, and the

* Factor analysis is a statistical technique for classifying complex data into more simple terms. In this case, the object is to replace the lengthy description of a patient as "so much in symptoms a, b, c, d, e, f, . . ." by the more concise "so much factor A plus so much factor B plus so much factor C." The factors (obtained by the present method) are independent of each other, while the symptoms are not.

† The factors resulting from this type of analysis are (1) a general factor, which represents those attributes common to every symptom in the data, (2) bipolar or group factors, which represent attributes common to some but not all of the symptoms, and (3) specific factors which are peculiar to a single symptom. As Burt has pointed out, these are merely the old classificatory principles, genus, species, and proprius, of the logicians. The saturation of a factor with a symptom represents the degree of correlation of the trait with the factor, in a way exactly similar to the ordinary correlation coefficient. Thus the score in the general factor represents the answer to a question such as "How much of the features common to all cases of blankitis does X have?", and the score in the bipolar factor answers the question, "Now entirely, apart from blankitis, does X incline more to the thin or the stout side, and how much?"

diagnostic rating, psychic anxiety. J also gave the rating somatic anxiety a fairly high saturation here, but T did not. Presumably this general factor can be taken to represent the common features of psychological maladjustment as shown by repatriated prisoners of war.

The chief bipolar factor has very similar saturations in each set of data. The main positive loadings are effort intolerance, breathlessness, palpitation, and the diagnosis, somatic anxiety. The main negative loadings are depressed, asocial, shy of females, don't belong, and the diagnosis, depression. The group factors 1 and 2 correspond to this bipolar factor. Obviously this factor serves to classify patients on a scale we might call effort syndrome *versus* depressed/withdrawn. On T's second bipolar factor little stress should be laid, since it is entirely absent in J's data. Its saturations do, however, achieve significance according to Burt's criterion (Burt and Banks, 1947) and appear to make sense, being resentment, cooped up, anorexia and headache, *versus* don't belong, lack of confidence, and asocial.

The interpretation of these findings seems to lie clearly with one of two alternatives. Possibly the results reflect merely the prejudices of the investigators, who were admittedly particularly interested in effort syndrome, and who might be imagined (though with difficulty) to have grown such very similar prejudices over a previous 6 months of working together. If this explanation is discounted, then effort syndrome and depressed/withdrawn reaction are two independent ways in which men with little predisposition to the classical types of psychoneurosis may react to circumstances which they can neither tolerate nor alter. Such a view is neither startling nor new, and accords well with the current conceptions of effort syndrome as a neurotic reaction, and with experience of minor neuroses in army and civilian practice.

The scheme of diagnosing under the three headings somatic anxiety, psychic anxiety, and depression seems to have been fairly well justified. Both investigators used somatic anxiety primarily to designate effort syndrome, though J did not disentangle his rating enough from the general factor. J has, however, expressed his general factor very clearly in the diagnosis of psychic anxiety, which for him is independent of the bipolar factor. T's psychic anxiety diagnosis was a mixture of general factor (which did predominate) and depression/withdrawal. The diagnosis depression represented well the depression/withdrawal symptoms, though it also, for J, was contaminated slightly with general factor. Some such scheme of symptom diagnosis may prove useful in the study of neurotic reactions,

at least until more fundamental work on the genesis of these reactions and their physiological bases is forthcoming. It would certainly be desirable to see if non-hysterical neurotics not distinguished from the usual patient by being subjected to the particular stress of prisoner-of-war life could be usefully summed up under the headings general anxiety rating, effort syndrome rating, depression/withdrawal rating.

It will be seen in Tables II and III that some of the symptoms have very low communalities. This means that our classification has left them out of account; that they are largely independent of our factors, and of each other. For this reason they are of considerable interest. Anorexia, insomnia, trembling (which is only slightly allied with effort syndrome) are in this category; so are less sex desire, shortness of temper, resentfulness, and a feeling of being cooped up. These symptoms do not depend on the general severity of the patient's condition, nor on his degree of effort syndrome or depression, and emphatically demand further investigation.

RELATION OF SYMPTOMS TO ENVIRONMENTAL STRESS AND PHYSICAL CONSTITUTION.—The bipolar factor being unearthed, the question immediately arises as to what makes a man gravitate to one end or the other of it. Can a man react to psychological stress with a well-marked effort syndrome at one time in his life, and an asocial depression at another? Are the factors governing his reaction chiefly genetic and constitutional or chiefly environmental? This question we shall now attempt—quite unsuccessfully—to answer.

Every individual's score in the general and the bipolar factor was worked out from the estimation equations below. The multiple correlations (*R*) of the estimates with the factor are also given.

General factor (*T*)=0.5 lack concentration+0.2 shy females+0.2 fatigue−2.8 (*R*=0.76)

General factor (*J*)=0.9 psychic anx.+0.1 somatic anx.−3.2 (*R*=0.79)

Bipolar factor (*T*)=0.6 effort intolerance−0.4 depressed−0.3 (*R*=0.92)

Bipolar factor (*J*)=0.4 som. anx.+0.3 effort intol. −0.6 depression −0.3 shy females −0.1 (*R*=0.93)

Environmental Relations.—These factor estimates were then correlated with the ratings for various items in the history of each individual; the rating and discussion of these items will be found in the paper at p. 53 of this issue. No significant relation could be discovered with early-environment-adverse rating, total time of captivity, rating of physical health while in captivity, or age. A consistently

positive relation between the prisoner-of-war camp stress rating and the general factor was found, the coefficients being +0.27 for J and +0.17 for T, which, taken together, are significant at the 0.05 level. They are small though reasonable, and may, of course, represent purely a halo effect on the part of the investigators.

Constitutional Relations.—The physique of 89 of these 100 men was investigated by the method of Sheldon (1940). Somatotyping was done anthroposcopically from the usual three pictures, with reference in the majority of cases to the Ht-Wt index at age 18. The measurements recommended by Sheldon were taken, and will be reported later, but nearly all our men were above the age range of Sheldon's tables. The somatotyping of all the men was done by one of the investigators, who had had special training in this procedure.

No relation could be demonstrated between the general factor score and somatotype, but equivocal results were obtained for the bipolar factor. For J's subjects, the correlations of endomorphy, mesomorphy, and ectomorphy, and this factor were all insignificantly low. For T's subjects,

however, they were respectively +0.37, -0.36, and +0.19, the first two being significant. This might be dismissed as prejudice, were it not that T's conscious predilections, at least, were quite in another direction, in favour of the third figure being the high one. More of the total symptom variance enters into T's bipolar factor than into J's and this might be taken as supporting the repeatability of T's figures. Future work must decide the question, but the suspicion, at any rate, is raised that the more mesomorphic people become depressed and asocial under stress rather than short of breath, and that both increasing endomorphy and ectomorphy predispose in the other direction. (The partial correlation of endomorphy and the bipolar factor with ectomorphy held constant is 0.47, and of ectomorphy and the bipolar factor with endomorphy held constant 0.34.) The correlations between somatotype and the symptoms effort intolerance and shortness of breath support this idea. J's subjects did have negative correlations between these symptoms and mesomorphy, of -0.19 and -0.25, but, taken in isolation, these could be merely due to chance. The equivalent correlations for T were -0.25 and -0.17. J's data also showed

TABLE II
BIPOLAR FACTOR SATURATIONS

Symptom	Bipolar (i)		Bipolar (ii)	General		Communality	
	T	J	T	T	J	T	J
Effort intolerance	0.77	0.63	-0.20	0.55	0.66	0.94	0.83
Breathlessness	0.72	0.46	-0.16	0.37	0.63	0.68	0.61
Somatic anxiety	0.59	0.42	+0.13	0.24	0.74	0.42	0.72
Palpitation	—	0.35	—	—	0.53	—	0.40
Trembling	0.29	0.10	-0.21	0.06	0.31	0.13	0.11
Insomnia	0.19	0.10	-0.06	0.21	0.37	0.08	0.15
Less sex desire	0.16	-0.12	+0.08	0.37	0.44	0.17	0.21
Headache	0.16	—	+0.41	0.43	—	0.38	—
Sweating	0.13	—	-0.08	0.41	—	0.19	—
Fatigue	0.12	0.26	-0.14	0.51	0.56	0.28	0.38
U.K. morals worse	—	0.18	—	—	0.32	—	0.13
Hypochondriacal	0.09	—	+0.39	0.44	—	0.36	—
Lack of concentration ..	-0.05	-0.15	+0.21	0.59	0.44	0.39	0.22
Cooped up	-0.08	-0.33	+0.42	0.22	0.17	0.23	0.14
Short-tempered	-0.13	-0.01	+0.27	0.28	0.40	0.17	0.16
Don't belong	-0.16	-0.40	-0.43	0.41	0.62	0.38	0.54
Resent army	-0.17	+0.19	+0.53	0.05	0.29	0.31	0.12
Anxious expectation ..	-0.17	+0.22	-0.23	0.45	0.61	0.28	0.42
Lack confidence	-0.18	-0.15	-0.29	0.48	0.28	0.35	0.10
Shy females	-0.24	-0.43	-0.04	0.64	0.52	0.47	0.46
Anorexia	-0.25	-0.01	+0.44	0.20	0.42	0.30	0.18
Psychic anxiety	-0.39	-0.06	-0.27	0.56	0.77	0.53	0.60
Depression	-0.39	-0.52	-0.25	0.35	0.56	0.34	0.58
Asocial	-0.41	-0.38	-0.27	0.46	0.64	0.45	0.55
Depressed	-0.61	-0.33	-0.22	0.47	0.50	0.64	0.36
Contribution to variance ..	12%	10%	8%	17%	26%	37%	36%

significant relation of these symptoms to ectomorphy (+0.20 and +0.30), which T's did not. T, on the contrary, obtained the significant figures with endomorphy of +0.31 and +0.32. On the other end of the factor, T's figures for asocial and depression are, endomorphy -0.29 and 0.00, mesomorphy +0.23 and +0.23. J has no significant correlations here, and neither investigator has significant correlations between somatotype and shy of females or lacks confidence.

Since endomorphy and ectomorphy are positively correlated and mesomorphy negatively correlated with the femininity component of male physique (Sheldon, 1942), it is possible that the relation may be with this component rather than with the somatotype components *per se*. Such a relation would be indicated by the pathological physiology of effort syndrome (Tanner, 1948a), but, as we have been unable to demonstrate that exercise response itself in these patients is related to the bipolar symptom factor, we must leave this matter undecided.

The somatotype components are independent of gross body size. The factor analysis classification of physique, however, leads to an expression for body size in the form of a regression equation involving height, weight, and

leg length (Burt, personal communication). We did not have the last of these available, but it has been shown that, in fifty students, the Du Bois surface area expression correlated with the size factor regression estimate to the extent of 0.99 (Tanner, 1948b). Consequently surface area was used as a measure of gross size.

Neither factor estimate showed a significant relation with body size. The general factor correlated -0.21 for both J and T, and this might be considered suggestive, particularly in view of Eysenck's finding (1947) that men of small size, or microsomatics, have more adverse symptoms attributed to them by their psychiatrists than do macrosomatics. The bipolar factor estimate correlated -0.19 and -0.24 for J and T; again insignificant, though possibly suggestive that larger people gravitate towards depression rather than effort syndrome.

Neither the rating of constitutional predisposition nor the progressive matrices score was found to correlate with either general or bipolar factor.

Physiological Response to Exercise

Sixty-five of the hundred men (40 of J's series and 25 of T's) were subjected to a standardized exercise tolerance test on a bicycle ergometer in the way previously described (Jones and Mellersh, 1946a). The subject

TABLE III
GROUP FACTOR SATURATIONS

Symptom	General		Group 1		Group 2		Group 3		Communality
	T	J	T	J	T	J	T	T	J
Lack concentration ..	0.76	0.43	—	0.21	—	—	—	0.58	0.23
Shy females ..	0.56	0.35	0.47	0.63	—	—	—	0.53	0.52
Fatigue ..	0.55	0.49	0.24	—	—	0.38	—	0.36	0.38
Less sex desire ..	0.51	0.48	—	—	—	—	—	0.26	0.23
Hypochondriacal ..	0.50	—	—	—	—	—	0.26	0.32	—
Anxious expectation ..	0.46	0.58	0.24	—	—	0.26	—	0.27	0.40
Psychic anxiety ..	0.46	0.87	0.43	—	—	—	—	0.40	0.76
Headache ..	0.45	—	—	—	—	—	0.35	0.33	—
Sweating ..	0.40	—	—	—	0.39	—	—	0.31	—
Palpitation ..	—	0.43	—	—	—	0.43	—	—	0.37
Effort intolerance ..	0.24	0.39	—	—	0.86	0.88	—	0.80	0.93
Don't belong ..	0.22	0.49	0.47	0.57	—	—	—	0.27	0.57
Short-tempered ..	0.21	0.46	—	—	—	—	0.33	0.15	0.21
Lack confidence ..	0.20	0.21	0.65	0.24	—	—	—	0.46	0.10
Insomnia ..	0.19	0.32	—	—	0.19	0.21	—	0.07	0.15
Depressed ..	0.13	0.40	0.66	0.44	—	—	—	0.45	0.26
U.K. morals worse ..	—	0.27	—	—	—	—	—	—	0.13
Cooped up ..	0.08	0.00	—	—	—	—	0.48	0.24	0.21
Anorexia ..	0.07	0.45	—	—	—	—	0.47	0.23	0.20
Breathless ..	0.05	0.48	—	—	0.90	0.60	—	0.81	0.59
Asocial ..	0.02	0.53	0.89	0.54	—	—	—	0.79	0.57
Somatic anxiety ..	0.00	0.62	—	—	0.63	0.60	—	0.40	0.74
Depression ..	-0.04	0.38	0.61	0.70	—	—	—	0.37	0.48
Trembling ..	-0.07	0.32	—	—	0.33	—	—	0.11	0.10
Resent army ..	-0.24	0.23	—	—	—	0.25	0.90	0.87	0.12
Contribution to variance ..	12%	20%	12%	8%	10%	9%	7%	41%	38%

bicycled at forty-two revolutions per minute for five minutes, doing approximately 930 kg.m./min. work against friction. Unfortunately the time between admission to hospital and the test could not be made completely uniform for each man, but it was about two weeks in most cases. Some degree of symptomatic recovery had occurred by this time, but by no means as much as was finally recorded. Resting pulse rate after twenty minutes' rest before exercise was recorded; and, during the first five minutes after exercise had ceased, total ventilation, respiratory rate, oxygen consumption, oxygen equivalent (the volume of air breathed for the assimilation of 100 ml. of oxygen) and pulse area. The last expression measures the rapidity with which the heart rate returns to the resting value, and is the number of heart beats during the first four minutes post exercise, plus the mean heart rate during the eighth, ninth, and tenth minute post exercise, and minus five times the resting rate.

Table IV compares the physiological measurements during the recovery from exercise of the present patients, 20 normal controls, and 47 patients with well-marked effort syndromes or anxiety states. The controls and the 47 effort-syndrome-anxiety states have been reported previously (Jones and Mellersh, 1946b); the controls were somewhat unathletic soldiers of approximately the same age and weight range as the neurotics. The 20 patients in the last row of Table IV are 20 of the 47 men of the row above. It will be seen that the neurotics have a larger oxygen consumption than the controls ($P < 0.01$), a larger pulse area ($P < 0.01$), a greater ventilation, mainly because of greater respiratory rate, and higher oxygen equivalent, signifying a ventilation in excess of that needed to supply the oxygen requirement. In all these measurements, the present prisoner-of-war patients lie between the neurotics and the normals. Though the mean oxygen consumption of the prisoners of war does not differ from that of the controls, the hypothesis that

both are samples from the same, healthy population is untenable, for a significant difference ($P < 0.01$) exists between the standard deviations of the two series. The prisoners of war, in their greater scatter, are half way to the neurotic figure. The pulse area mean of the prisoners of war lies in between the neurotic and the control figures, and is significantly different ($P < 0.01$) from either of them. In total ventilation, respiratory rate, and oxygen equivalent the prisoners of war fall between the other two groups.

The interpretation of the neurotics' poor response to submaximal exercise is not yet perfectly clear. The subject is to be reviewed elsewhere (Tanner, 1948a). It is thought very probable that in the neurotic excessive anaerobic muscular contraction takes place at the beginning of exercise, and the suggestion has been put forward that this is due to an initially insufficient dilatation of the muscular vessels. It has been shown that the response is worse in chronic lifelong effort syndrome cases than in acute ones (Jones and Scarisbrick, 1946; Cohen, and others, 1947) and the question arises as to whether our prisoner-of-war figures coincide with those for the acute effort syndrome or anxiety state without constitutional predisposition, or whether they are still closer to normal. This cannot be dogmatically answered from the figures available, but it does seem that both oxygen consumption and pulse area of the prisoners of war are somewhat less than for the acute anxiety states. The physiological studies, then, lead us to the conclusion that the prisoners of war are men with little or no constitutional predisposition to neurosis, and are suffering from a rather milder attack of anxiety than the usual army patient referred to a neurosis centre with a short history of illness. This conclusion fits exactly with our clinical impression and

TABLE IV
COMPARISON OF FIVE-MINUTE POST-EXERCISE MEASUREMENTS OF NORMALS,
EX-PRISONERS OF WAR, AND ANXIETY STATES

	5 min. recovery oxygen consumption ml/min.		Pulse area		Ventila- tion l/min.	Respira- tory rate per min.	Oxygen equiva- lent	Volume per breath ml.
	Mn.	S.D.	Mn.	S.D.				
20 normal	586	35.9	86	35.8	17.0	18	2.9	929
65 ex-P.O.W.	589	60.5	122	38.8	21.4	24	3.6	1,092
47 effort syndrome plus anxiety state ..	693	91.6	145	40.5	—	—	—	—
20 effort syndrome plus anxiety state ..	—		—		28.3	28	3.9	985

with the psychometric results (psychological questionnaire, body sway suggestibility, dark vision). (Eysenck, 1947, p. 255.)

Relation of Physiological Measurements and Psychological Symptoms

The estimates of the general and bipolar factors were then correlated with these physiological measurements. For the general factor, the only significant relation was with oxygen equivalent, the coefficient being $+0.25$ ($P=0.05$). Though the other measurements will successfully differentiate degrees of neuroticism in a heterogeneous population, oxygen equivalent appears to be the only measurement sensitive enough to reflect the severity of the anxiety within our homogeneous group. Our estimate of severity is, of course, a very imperfect one, and perhaps better quantitation in this direction, rather than in the physiological tests, is what is needed.

No significant relations distinguishing effort syndrome from depression/withdrawal were found. This result agrees with earlier findings on the inseparability by exercise response of effort syndrome cases and anxiety states in general. Poor effort response is by no means confined to patients who complain of it; it is a general characteristic of all neurotic patients except those with conversion hysteria.

The Relations of Physiological Measurements and Physique

Size Factor.—For the sixty-five subjects, the correlation coefficient of surface area with oxygen consumption was $+0.31$, and with pulse area -0.40 ; with resting heart rate and oxygen equivalent, insignificantly low. Oxygen consumption during moderate exercise, at any rate in the normal, is more highly correlated with size than this (Seltzer, 1940) while total recovery oxygen after slight to moderate work is independent of body weight (Berg, 1947). The latter result comes about because the speed of recovery is faster for those who at the start of recovery have a higher oxygen consumption. It thus seems probable that our relationship of 0.31 reflects our 5-minute oxygen collection: had we collected for less time, it would have been greater, and for more time, less. In comparing two groups, allowance should obviously be made for this size relation unless the time of collection is extended, say, to 7 or 8 minutes, sufficiently to reduce the correlation to insignificant levels. In the present data the regression of oxygen consumption on body weight is only 0.9 ml./min. per lb. however, and adjustment makes no difference to our conclusions, the difference in weight of

controls and prisoners of war being 5 lb. only, in favour of the latter. The same thing applies to pulse area; comparisons should be made with the size factor adjusted, though in the present instance the results are essentially unchanged.

Somatotype Component.—Only one significant relation was found between the somatotype components taken singly and oxygen consumption, pulse area, and oxygen equivalent. This was a correlation of 0.32 between endomorphy and oxygen equivalent, indicating that the higher the fat component, the less the efficiency of respiration following exercise. This relation is independent of the relation of oxygen equivalent to the general symptom factor, and presumably relates to a constitutional difference in exercise response, independent of any neurotic symptoms. Cureton and his associates (1945) found that performance in long-distance running was adversely affected by increasing endomorphy. Whether these relations mirror the masculine-feminine component of build, or endomorphy *per se*, is not yet clear; in our material the oxygen equivalent had no relation with the shoulder-width/hip-width ratio.

Particular interest attaches to the oxygen consumption figure, since Seltzer has reported that at rest and during moderate exercise linear people have larger consumptions than more lateral individuals of the same gross size (1940). It has been mentioned elsewhere, however, that Seltzer's conclusions do not necessarily follow from the figures he presents, and that his results may be explained entirely by the spurious correlation between indices introduced by his method of handling his data (Tanner, 1948c). All the same, the idea that thin people have a higher oxygen consumption than thick people is an old one (Harris and Benedict, 1919), and very indirect support for it may perhaps be found in the correlation of oral temperature and ectomorphy (Tanner, 1947). Since our data for recovery oxygen consumption reflect only slightly the consumption during exercise, we can throw no direct light on this problem. It seems worth while mentioning, however, that in T's series of subjects, though not in J's a positive correlation of oxygen uptake and ectomorphy was observed, reaching precisely the 0.05 level of significance, with the surface area effect partialled out. Though certainly no conclusion should be drawn from our figures, there does seem to be a strong case for reinvestigating this subject, both in normals and neurotics, during exercise and after it.

Discussion

The differentiation of neurotic patients into hysterics and dysthymics has recently been sum-

marized and discussed by Eysenck (1947). In this classification, all our patients were dysthymics, and what we have attempted is really a further splitting of this group into effort syndrome and depressed/withdrawal reaction. The effort syndrome end of this bipolar factor of ours is clearly visible at one pole of Eysenck's third factor, though depression does not appear there. It is interesting that the symptoms trembling and irritability, or their equivalents, had insignificantly low saturations in Eysenck's third factor and likewise in our bipolar; dyspepsia correlated with effort syndrome symptoms in his data, however, while anorexia did not in ours. While morphological and physiological differences can be shown to exist between hysterics and dysthymics, we were unable, at least in our small sample and with limited tests, to find surely significant differences between effort syndrome and depression/withdrawal. A morphological difference, with mesomorphs becoming depressed, and ectomorphy and endomorphy increasing the chances of effort syndrome, is suggested but by no means established by this study.

It may be that these two ways of reacting to stress do not differ so fundamentally as the hysteric and dysthymic syndromes: but only studies showing whether a second breakdown is as often the opposite as the same in symptomatology can throw light on this, and, in any case, further physiological tests both of constitutional and reactive functions are obviously indicated.

It does not seem probable that our general factor is equivalent to Eysenck's personality organization (P) factor. There is no correlation between our ratings of constitutional predisposition and our general factor score, whereas the psychiatrists rating, "badly organized personality," had a saturation of 0.92 in P in the Mill Hill study. Rather, the general factor may be regarded as an estimate of the severity of the maladjustment peculiar to returned prisoners of war. It would be interesting to see if the factor were present to a lesser extent in repatriated prisoners of war and other repatriates who suffered no overt breakdown: general experience of such people suggests that this may be the case. If so, this factor may have wider implication, and represent the common reaction upon return of persons who have been separated from their social group.

Summary

1. One hundred soldiers, repatriated prisoners of war from North-west Europe who had been sent to a neurosis rehabilitation unit, were examined by two psychiatrists, fifty men by each. Sixty-four possible symptoms were inquired into in detail, and the severity of each rated on a seven-point scale. Three

diagnostic categories, somatic anxiety, psychic anxiety, and depression were also rated. There were no hysterics in the sample. Twenty-two of the symptoms were relatively common, and the scores in these and in the three diagnoses were inter-correlated separately for each observer. The correlation matrices were then factor-analysed, and yielded a general factor and a chief bipolar factor. The saturations for the two investigators agreed well. The general factor represents the syndrome peculiar to returned prisoners of war: it is suggested that such a syndrome, in less severe form, may be characteristic of all expatriates upon return to their parent social group. The bipolar factor represents effort syndrome versus depression/withdrawal reaction. The diagnostic categories were found to describe fairly well effort syndrome group, general factor, and depression/withdrawal group respectively, and the suggestion is made that descriptive diagnoses of non-hysterical neurotics should be couched in something like these terms.

2. Factor scores were estimated, and the relations of factor score to various ratings of environmental stress and to constitution and physique were examined, in an effort to see which influenced chiefly the type of neurotic symptoms. The effort was largely unsuccessful, and few conclusions could be drawn. It appears, however, that patients high in mesomorphy may tend to become depressed rather than to have effort syndrome. Both increasing ectomorphy and endomorphy enlarge the chances of getting effort syndrome; the relation may be primarily with the masculine-feminine component of physique.

3. Sixty-five of these hundred men underwent a standard exercise test on a bicycle ergometer. Figures for resting pulse rate and for post-exercise oxygen consumption, pulse area, oxygen equivalent, ventilation, and respiratory rate are reported, and compared with those of normal controls and of the usual hospitalized army anxiety-state patients. In every measured characteristic, the repatriated prisoners of war were found to lie between the other two groups, and this is taken as evidence that the prisoners of war were little predisposed to anxiety, and only mildly affected by it.

4. There was a significant positive relationship between the general symptom factor and oxygen equivalent, that is, the amount of air ventilated for the assimilation of 100 ml. oxygen. No significant relations distinguishing effort syndrome from depressed/withdrawal were found; poor effort response characterizes all neurotics except those with conversion hysteria, and is not, in this mildly ill group, demonstrably worse in those who complain primarily of it.

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