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PERSONALITY AS A DETERMINANT OF PAIRED-ASSOCIATES LEARNING

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Summary.—Predictions based on theories of verbal learning proposed by Spence and Eysenck were compared by presenting either a non-competitive or competitive list of paired-associates to groups of sixth form grammar school boys containing 42 and 59 *Ss* respectively. The only relation found between drive level as measured by either the MAS or A-state scale was that medium-scoring MAS *Ss* performed significantly worse than high- or low-scoring *Ss* on the competitive list. Support was obtained for the hypotheses, firstly, that performance would be related to Eysenck's hypothetical dimension of arousal ranging from stable extraversion to neurotic introversion in the manner described by the inverse-U relation, and, secondly, that good performance on the competitive list would be related to extraversion.

The study reported was an attempt to compare the applicability to a paired-associate learning task of predictions derived from two theories relating personality to verbal learning proposed respectively by Spence (1956, 1958; Taylor, 1956; Spence & Spence, 1966) and by Eysenck (1965, 1967, 1973).

The word lists used were taken from a study by Spence, Farber, and McFann (1956). They designed two lists of paired-associates so as to either minimize or maximize competing, incorrect S-R tendencies. The former list was also assumed to provide an initial associative connection between each paired S and R term acquired as a result of extra-experimental experience. On the basis of Spence's drive theory, Spence, Farber, and McFann predicted that, because of the hypothesized multiplicative relationship between drive and habit in determining excitatory potential, high drive would improve performance on the first list where correct responses were dominant but worsen performance on the second list where incorrect responses were dominant. Drive was varied by testing *Ss* who had scored in either the upper or lower quintile on the Manifest Anxiety Scale (Taylor MAS; Taylor, 1953), designed to measure individual differences in emotional responsiveness which are assumed in Spence's theory to contribute to drive level. The predictions were upheld in both this study and another in which almost identical lists were used (Spence, Taylor, & Ketchel, 1956).

Having reviewed many studies designed to test aspects of Spence's theory linking personality and learning, Eysenck (1973) has argued that their interpretation is extremely difficult owing to the Taylor MAS being a factorially complex measure correlating 0.3 to 0.4 with the introversion pole of one of his

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own major orthogonal factors of personality, extraversion-introversion, and 0.6 to 0.7 with the neuroticism pole of the other, neuroticism-stability.

Eysenck (1967) has postulated a physiological basis for differences in extraversion and neuroticism according to which introverts are characterized by high cortical arousal and high neuroticism scorers by high limbic activation. Extraversion and neuroticism are seen as independent except on the occurrence of strong emotion in the individual, when high arousal is also automatically produced. In extending his personality theory to include predictions about verbal learning, Eysenck (1965) argued that greater cortical arousal would cause a stronger and more prolonged consolidation process which would temporarily interfere with performance but result in better ultimate memory.

In a test of this theory, in which extraversion scores were used as a measure of arousal, Howarth and Eysenck (1968) found on a paired-associate learning task of seven CVCs of medium association value that extraverts took fewer trials than introverts to learn the list and showed higher immediate recall although these effects were not significant. There was, however, a significant interaction effect between extraversion and recall intervals ranging from immediate recall up to a delay of 24 hr. Working on the same hypothesis, McLaughlin (1968) used a list of 12 paired-associates with three-letter words as stimuli and 40% association value nonsense syllables as responses. He showed that extraverts took significantly fewer trials to learn the list but found no support for the predicted interaction effect when comparing varying recall intervals of up to seven days.

The results of a complex factor analytic study of various serial learning and short-term memory tasks in which extraverts performed much better than introverts led Jensen (1964) to suggest that extraverts show greater resistance to response competition. In a direct test of this effect on paired-associate learning, Howarth (1969) obtained response competition by changing the S-R combinations within a five-pair word list once it had been learnt. Extraverts took non-significantly fewer trials than introverts to learn the first two list combinations and significantly out-performed the introverts on the third list in which response competition was hypothesized to be at a maximum.

Predictions concerning the effect of extraversion and neuroticism on paired-associate learning based on both Eysenck's and Jensen's theories were tested in a study by McLaughlin and Eysenck (1967). They constructed an easy and a difficult list of seven CVC pairs with identical stimuli but different responses so that in the former list the responses were of low similarity to each other but in the latter were of high similarity. It was argued on the basis of Eysenck's theory that both high introversion and high neuroticism should contribute to a state of high arousal. Considering this argument and the well known inverse-U relation between arousal and performance, it was predicted that for the easy task stable

extraverts would be at suboptimal and neurotic introverts at superoptimal arousal levels, and these two groups were found to perform less well than the intermediate groups. On the difficult task the prediction that a lower level of arousal would be optimal and hence that a relative improvement would be expected for the stable extraverts and a relative decline for the neurotic introverts was also upheld with the stable extraverts performing best and the neurotic introverts significantly poorer. McLaughlin and Eysenck also found a significant superiority of extraverts over introverts which was much more marked in the difficult list, and they regarded this as partial support for Jensen's suggestion that extraverts are particularly at an advantage when resistance to response competition is involved.

Spielberger (1966) has suggested the need to distinguish between anxiety conceptualized as a transitory emotional state of the organism (A-state) and as a relatively stable personality trait (A-trait). Spielberger, Gorsuch, and Lushene (1970) have produced an A-state anxiety scale designed to determine the actual levels of A-state intensity induced by stressful experimental procedures or to provide an index of drive level as this concept is defined in Spence's theory, and also an A-trait anxiety scale designed to differentiate individuals in their tendency to respond to situations perceived as threatening with elevations in A-state intensity. Whether individuals differing on A-trait will show corresponding differences on A-state depends on how threatening or dangerous a situation is perceived to be. From intercorrelations obtained between the A-trait scale and the Taylor MAS the authors concluded that these can be considered as alternative measures of A-trait.

A study by O'Neil, Spielberger, and Hansen (1969) in which mathematics concepts were learned by Computer-assisted Instruction clearly supports Spielberger's contention that state and trait anxiety must be distinguished. There was a significant interaction between difficulty level and A-state level showing that high A-state *Ss* performed better where the mean number of errors per correct response was low but that low A-state *Ss* performed better where the mean number of errors per correct response was high. A similar comparison between high and low A-trait scorers, however, failed to yield any significant differences. Thus, the performance of individuals whose A-state and A-trait scores were inconsistent was determined more by their level of state than of trait anxiety, and whereas the results with the former scale were consistent with drive theory those with the latter were not.

In the present study *Ss* completed both the Taylor MAS and a questionnaire designed to measure Eysenck's extraversion and neuroticism personality factors. Additionally, immediately prior to being tested on the word list they filled in the A-state anxiety scale. The predictions derived from the theories of Spence and Eysenck were compared by analysing the results of the two learning tasks

separately for the different personality measures. Following Spence, Farber, and McFann (1956) it was hypothesized that on the non-competitive list *Ss* with high drive, as determined by scores on the Taylor MAS, would perform better than those with low drive, but that on the competitive list the low drive *Ss* would show superior performance. It is possible that the conditions of the present experiment would not be so stressful as those of the original study in which case, following the argument of Spielberger (1966), the above predictions would be expected to hold only when drive level is measured by the A-state scale. Following McLaughlin and Eysenck (1967) it was hypothesized that performance would be related to arousal in the manner described by the inverse-U curve. For the non-competitive list stable extraverts would possess suboptimal and neurotic introverts superoptimal arousal, and hence both groups would perform worse than *Ss* in the other two personality quadrants. On the competitive list the optimal level of arousal would be lower and hence performance would be expected to worsen as we move further along the hypothetical continuum of arousal through stable extraverts, the intermediate groups of neurotic extraverts and stable introverts, and, finally, neurotic introverts. On the basis of Jensen's (1964) suggestion that extraverts show greater resistance to response competition than introverts, it was further hypothesized that on the competitive list good performance would be positively related to extraversion.

METHOD

Subjects

Ss were 101 grammar school boys, aged between 16 and 18 yr., of whom 42 were tested on the non-competitive and 59 on the competitive paired-associate list.

Personality Tests

Ss were first tested in groups on Eysenck's latest Personality Questionnaire (PQ) from which scores for extraversion and neuroticism were obtained, and on the Taylor MAS.

Word Lists

The two lists, identical to those used by Spence, Farber, and McFann (1956), are shown in Table 1. The non-competitive list "consisted of 15 pairs of two-syllable adjectives . . . constructed in such a manner as to maximize closeness (strength) of association between paired stimulus-response words. Meaningful intralist associations and formal similarities were minimized. Thus, no beginning letter or suffix was repeated within the stimulus or response list and no stimulus-response pair began with the same letter or had the same suffix" (Spence, Farber, & McFann, 1956, pp. 299-300). The results to be presented for the competitive list refer to performance on eight out of the 12 pairs used in the list and shown in Table 1. The remaining four pairs (marked by an asterisk) were based on the non-competitive list. These four pairs were used in the original study to test an hypothesis not considered here, and to help produce response competition in the other eight pairs. "The associative connections between the words of these pairs were very high. For each of the stimulus words of these four pairs two synonymous adjectives were selected as stimulus words. . . . Each of these eight stimulus words was paired with an adjective with which it had little or no associative connection" (p. 301). "As a result, the learning of the pairs involving these stimuli . . . would involve a strong com-

TABLE 1

NON-COMPETITIVE AND COMPETITIVE WORD LISTS

Non-competitive List		Competitive List	
Stimulus	Response	Stimulus	Response
Adept	Skillful	*Barren	Fruitless
Barren	Fruitless	Arid	Grouchy
Complete	Thorough	Desert	Leading
Distant	Remote	*Little	Minute
Empty	Vacant	Petite	Yonder
Frigid	Arctic	Undersized	Wholesome
Insane	Crazy	*Roving	Nomad
Little	Minute	Gypsy	Opaque
Mammoth	Oversize	Migrant	Agile
Pious	Devout	†Tranquil	Placid
Roving	Nomad	Quiet	Double
Stubborn	Headstrong	Serene	Headstrong
Tranquil	Quiet		
Urgent	Pressing		
Wicked	Evil		

*S-R terms in the competitive list that were based on the non-competitive list.
†This pair, though not identical with the corresponding pair in the non-competitive list, was used because it was given in the original study.

peting response tendency, one, in fact, that is stronger than that to its paired response" (p. 299). Additionally, there was a practice list of six pairs of simple words chosen to show no relationship to the experimental lists. The lists were set up in block capitals on 16-mm. film in three different random orders and were presented on a screen by back projection from a 'Specto' projector. A digit timer was used to control the rate of presentation, each stimulus word being presented for a 1.67-sec. anticipation interval, followed by the appropriate response word for 2.33 sec. There was a 4-sec. intertrial interval.

Testing

Ss were tested individually in a small room which was semi-darkened during the presentation of the lists. *Ss* were asked to attempt to anticipate the correct response upon seeing the stimulus word and three trials were given on the practice list. Next the A-state scale was completed. *S* was then told that testing would continue until he had anticipated the complete list correctly on two successive occasions, and he was asked to concentrate on attempting to anticipate the response on each stimulus presentation. In practice, testing had to stop after 36 trials as *Ss* were only available for one school lesson.

RESULTS

Both lists were scored for the total number of errors and the number of trials to criterion. For nine *Ss* who had failed to reach criterion after 36 trials on the competitive list, the values obtained at this point were used in the analyses.

For each list a correlation matrix was constructed using error and trial scores as variables along with Taylor MAS, A-state, extraversion and neuroticism

TABLE 2

CORRELATIONS BETWEEN PERSONALITY AND PERFORMANCE ON NON-COMPETITIVE AND COMPETITIVE LISTS

	1	2	3	4	5	6
1. Errors		.88‡	−.08	.20	.16	−.03
2. Trials	.86‡		−.18	.08	.17	−.04
3. Taylor	−.13	.01		.32†	−.16	.77‡
4. A-state	.14	−.01	.08		−.27*	.15
5. Extraversion	−.22*	−.26†	−.23*	−.13		−.12
6. Neuroticism	−.07	.13	.75‡	.05	−.29†	

Note—Results for the non-competitive list are above the leading diagonal.
*$p < .05$ (one-tailed test). †$p < .025$ (one-tailed test). ‡$p < .005$ (one-tailed test).

scores. The matrix is presented in Table 2. The only significant correlations between measures of performance and personality showed extraversion to relate to good performance on the competitive list (Errors: $r = -.22$, $p < .05$; Trials: $r = -.26$, $p < .025$, one-tailed tests).

To test further the relationships between performance and personality scores, *Ss* in each experimental group were divided in three different ways. Firstly they were divided according to whether they showed low, medium, or high scores on the Taylor MAS. These three subgroups were made as equal in size as possible while ensuring that identical cut-off points were used for the two experimental groups. Secondly, a similar method of division was adopted this time considering A-state scores. And, finally, *Ss* were divided about the mean scores on extraversion and neuroticism in order to form four extraversion-neuroticism quadrant subgroups. Comparisons between the subgroups, for each method of division, were made by separate analyses of variance on error and trial scores. The results obtained were, of course, very similar: these two measures correlated .88 for the non-competitive and .86 for the competitive list. The results presented here refer specifically to the error data. Logarithmic transformations were used as subgroup standard deviations were clearly directly proportional to the means.

Fig. 1 shows the performance of low-, medium-, and high-scoring Taylor MAS *Ss* on the two lists. It can be seen from Fig. 1 that there is a tendency for performance on the non-competitive list to improve with higher Taylor MAS scores but the difference between the subgroups is quite insignificant. There is, however, a significant difference ($p < .025$) between the low, medium, and high Taylor MAS *Ss* on the competitive list, but, as is shown by Fig. 1, this finding indicates a tendency for medium scoring *Ss* to perform poorer than those with either high or low scores.

Whereas performance on the non-competitive list was shown to improve slightly with increasing Taylor MAS scores, a comparison between subgroups formed on the basis of A-state scores showed the opposite trend. Again, how-

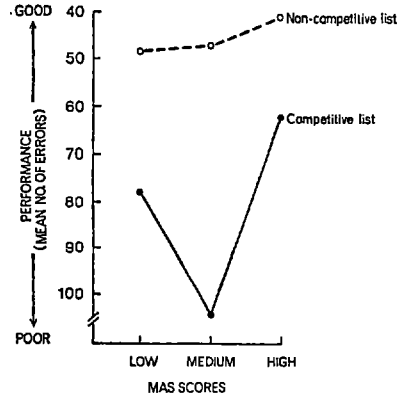

FIG. 1. The relationship between drive level as measured by Taylor MAS scores and performance on the non-competitive and competitive lists

ever, the differences are quite insignificant. On the competitive list the three subgroups had virtually equal scores.

Fig. 2 shows the performance of *Ss* in each of the four extraversion-neuroticism quadrants. It can be seen from Fig. 2 that the hypothesis of stable extraverts and neurotic introverts performing worse on the non-competitive list than neurotic extraverts and stable introverts is clearly supported by these data. The hypothesis that on the competitive list performance worsens as the hypothetical arousal level increases is only partially supported by the data. The stable extraverts are seen to perform better than the two groups hypothesized to be at a medium level of arousal which is the reverse of the relationship obtained with the non-competitive list. On the other hand, the neurotic introverts, who were expected to perform even more poorly than the medium arousal groups, in fact show better performance than these two groups although inferior performance to the stable extraverts. Analysis of variance on the data presented

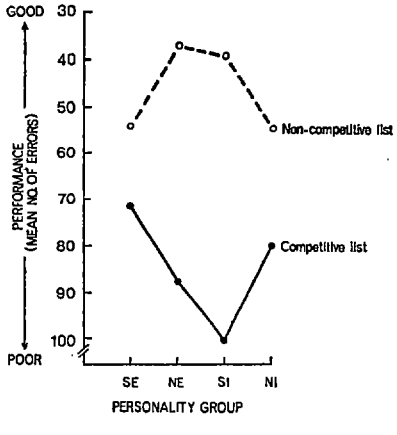

FIG. 2. The relationship between the hypothesized level of arousal as determined by extraversion-neuroticism personality groups and performance on the non-competitive and competitive lists

in Fig. 2 showed significant effects for List Difficulty ($p < .0001$) and List Difficulty $\times$ extraversion $\times$ neuroticism ($p < .05$).

Discussion

The hypotheses based on Spence's theory were not supported when drive level was measured by either the Taylor MAS or the A-state scale. In the present study scores on the Taylor MAS correlated lower than usual with introversion (.16 and .23 for the non-competitive and competitive groups respectively), but highly with neuroticism (.77 and .75), and, as might have been expected, a check showed that when drive level was compared by taking three levels of neuroticism rather than of Taylor MAS scores the results obtained were highly similar to those shown in Fig. 1. The marked inferiority in performance on the competitive list of medium-scoring *Ss* in comparison with those with high and low scores on the Taylor MAS was completely unexpected and cannot be explained in terms of either Spence's drive theory or the well known inverse-U relation between drive and performance.

Table 2 shows that the A-state scores correlated only slightly with either measure of trait anxiety, Taylor MAS or neuroticism. Spielberger, *et al.* (1970) report correlations between the A-state and A-trait scales of .51 to .67 for four different samples of male undergraduates, and of .44 to .55 for females, tested with standard instructions. To determine the correlation between the scales under differentially stressful experimental conditions, the A-trait scale was given before and after a testing session during which students were exposed to varying types and amounts of experimental stress. The A-state scale was presented four times during the session. Correlations between the scales ranged from .37 to .67 for the males and from .11 to .53 for the females. The correlations between Taylor MAS and the A-state scale in the present experiment are lower than most of those found by Spielberger, *et al.* between A-trait and measures of A-state obtained during the differentially stressful experimental conditions. This suggests that the testing situation was not sufficiently stressful to produce a strong relationship between trait and state anxiety. Thus, the failure to replicate the earlier results in favour of Spence's theory (Spence, Farber, & McFann, 1956) could be due to differences in experimental stress produced by the two studies.

However, the failure to support Spence's theory when A-state score is taken as the measure of drive is less easily explained. The correlations between A-state score and Taylor MAS are much lower than those obtained by Spielberger, *et al.* between A-trait and the A-state scale given with standard instructions. Thus, we assume the variance in A-state scores to be largely attributable to individual differences in anxiety induced by the experimental procedure. In the present experiment it was not possible to present the A-state scale during the testing session. *Ss* were not asked to complete the scale retrospectively because of the difficulty of defining the learning period being referred to: the number of trials

required to learn the list to criterion varied greatly. Presumably A-state level varied markedly as *Ss* learned the lists as it did between the learning of easy and difficult materials in the study by O'Neil, *et al.* (1969), but we have assumed that the A-state scores obtained are a valid indicator of *Ss'* anxiety levels relative to one another throughout the learning of the list. Spielberger, *et al.* showed consistently positive correlations between A-trait and the A-state measures obtained during the experimental session, and it seems likely that a stronger relationship held in the present study between the level of A-state induced by the practice session and that which actually occurred during testing. The absence of any relationship in support of Spence's theory whether drive level is measured by the A-state scale or by the highly related measures of trait anxiety, Taylor MAS and Eysenck's Neuroticism, casts doubt on the adequacy of these scales when considered independently to predict performance on such tasks as used here.

When extraversion is considered in addition to neuroticism the relation of personality to performance becomes much clearer. With the exception of the performance of the neurotic introverts on the competitive list the differences between the four extraversion-neuroticism quadrant groups shown in Fig. 2 largely support the hypothesis based on Eysenck's theory that performance is related to the hypothetical continuum of arousal, ranging from stable extraversion to neurotic introversion, in the manner described by the inverse-U curve. The findings are similar to those obtained by McLaughlin and Eysenck (1967). The performance curves they presented were constructed in a slightly different manner to those in Fig. 2 but if their results are re-plotted in the present form the similarity between the relationships shown by the two sets of data is striking. Both studies indicated stable extraverts and neurotic introverts performed clearly worse than the other two groups on the easier list, and also found, for the more difficult list, a very similar trend (see Fig. 2) although the change in trend occurring as we move from stable to neurotic introverts was not so marked in the earlier study.

More work will need to be undertaken before the relations between paired-associate learning and personality suggested by these two studies become clearly established, but assuming this pattern of results to be consistent it is necessary to attempt to explain why the performance of neurotic introverts in comparison with the other personality groups is better on the competitive list than was hypothesized. This may partly be due to the positive relation which appears to hold between both neuroticism and introversion on the one hand, and good academic performance on the other, in subjects of a similar scholastic level to those of the present study (Eysenck, 1971). Ability level should be controlled in future studies in order to test this possibility.

The hypothesis of a positive relation between extraversion and performance on the competitive list is supported by the results of the correlation analysis.

This adds further support to the suggestion made by Jensen (1964), and supported by the studies of McLaughlin and Eysenck (1967) and Howarth (1969), that extraverts are at an advantage when resistance to response competition is involved.

The results of the present study strongly support Eysenck's (1973) contention that in the investigation of personality differences in verbal learning both extraversion and neuroticism should be considered and not just drive level as measured by the Taylor MAS as has been the case in the vast number of studies following Spence's theoretical framework.

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