EXTRAVERSION, NEUROTICISM, AND SERIAL LEARNING [1]

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The Maudsley Personality Inventory (MPI), reviewed in this journal in 1958 (7), measures two relatively independent dimensions of personality: Extraversion-Introversion (E scale) and Neuroticism (N scale). The MPI derives its importance largely from its close connection with Eysenck's theory of personality, particularly his theory of extraversion-introversion (2). It has been amply shown that the MPI scales correlate with other questionnaire-type measures of personality and differentiate between certain selected groups of psychiatric patients (7, 3).

Theoretical interest in the MPI, however, is based more upon the correlations of the scales with fundamental psychological processes, such as perception and learning.

The prediction of correlations between extraversion-introversion (E-I) and various learning phenomena is derived from a combination of Eysenck's theory of E-I and a Hullian-type theory of learning (2). Eysenck has postulated that extraverts build up reactive inhibition (Hull's I_R) more rapidly and dissipate it more slowly than do introverts. Since, according to Hull's theory of learning, I_R depresses performance under certain conditions, extraverts and introverts should be expected to differ in their learning under these specified conditions.

Correlations between neuroticism and learning, on the other hand, are predicted by a theory, developed by Spence and Taylor (12), that anxiety (and thus possibly neuroticism) is a drive that facilitates the learning of simple tasks in, which there is little interference or response competition, and hinders the learning of complex or difficult tasks.

The theories and research relating learning both to extraversion-introversion and to neuroticism or anxiety have been comprehensively reviewed by Jones (10). The evidence for a relationship between neuroticism and learning efficiency is based mostly on the Taylor Manifest Anxiety Scale

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(MAS). As indicated by the Jones review, the relationship between the MAS and conditioning and learning is well established. Since the N scale of the MPI correlates .77 with the MAS (7), it is presumed that the N scale would show the same relationships with learing as the MAS. If this were in fact the case, the N scale could be definitely accepted as having the same relevance to anxiety-drive theory as the MAS.

Predictions from Eysenck's theory concerning the relationship between extraversion-introversion and learning, however, are borne out only tentatively by the research of the Maudsley laboratory (10). In fact, evidence that *either* of the MPI scales is related to learning is still quite meager and inconclusive. Ray (11), for example, found, in accordance with Eysenck's theory, that introverts were significantly superior to extraverts in pursuit-rotor learning, but found no relationship between learning and neuroticism. Bendig and Vaughan (1) found no significant relationships whatsoever between performance on a motor learning task (inverted alphabet printing) and either the E or N scales.

The present study investigates the relationship of the MPI scales to serial rote learning. The task consisted of learning by the anticipation method a series of nine colored geometric forms. Difficulty was controlled by varying the rate of serial presentation.

METHOD

Subjects. The MPI was given to 130 university students in an introductory course in educational psychology. Most of the subjects (*Ss*) were in the 19 to 21 age range; approximately two-thirds were women. The mean E score for all 130 *Ss* was 27.37, *SD* 9.82; the mean N score was 17.74, *SD* 11.14. The correlation between E and N was -.29.

From the total group were selected 32 *Ss* with high N scale scores (23-48) and 32 *Ss* with low N scores (0-10); these groups are referred to as High N and Low N. The 32 *Ss* with the highest E scale scores (32-48) and the 32 *Ss* with the lowest E scores (0-24) were also selected; these groups are referred to as Extraverts and Introverts.

Because of the negative correlation between E and N the mean N score of the Introverts (20.23) is higher than that of the Extraverts (15.56). And since *Ss* were selected from the extremes of the E and N distributions independently, there is considerable overlap between the two sets of extreme groups. That is, 37 of the *Ss* who were at the extremes on N were also at the extremes on E. The following table shows the overlap; more Introverts are high on N than Extraverts, and more Extraverts are low on N than Introverts.

	Extraverts	Introverts	
High N	7	12	19
Low N.	12	6	18
	19	18	37

Half of each group of 32 *Ss* was given the serial learning task at a 4 sec. rate of stimulus presentation and the other half of the *Ss* was given the task at a 2 sec. rate. The means and standard deviations of the MPI scores of the eight resulting groups are shown in Table 1 (lines 1 and 2).

TABLE 1

Means and Standard Deviations of Personality and Learning Measures

	4 Sec. Rate				2 Sec. Rate			
	Extraverts		Introverts		Extraverts		Introverts	
	M	*SD*	M	*SD*	M	*SD*	M	*SD*
1. E Scale	37.55	4.94	17.10	6.78	34.92	2.98	14.00	3.00
2. N Scale	14.05	8.13	21.20	11.59	17.03	7.55	19.25	8.78
3. Errors	52.60	20.21	54.55	28.92	72.58	21.68	90.75	32.56
4. Adjusted Errors . . .	54.75		52.70		73.04		89.99	

	4 Sec. Rate				2 Sec. Rate			
	High N		Low N		High N		Low N	
	M	*SD*	M	*SD*	M	*SD*	M	*SD*
1. E Scale	23.65	10.65	29.85	7.22	24.83	8.65	27.92	8.11
2. N Scale	31.40	5.92	6.85	2.59	29.67	5.78	9.00	2.08
3. Errors	49.60	21.95	59.45	48.83	91.83	25.88	63.42	27.27
4. Adjusted Errors	46.18		63.31		87.79		65.01	

Procedure. All *Ss* were given the same instructions. They were told that they were to learn the order in which a number of stimuli were to be presented. Learning was by the anticipation method and *Ss* were required to anticipate each stimulus on the very first trial, even though they had to resort to sheer guessing. They were told that there were nine stimuli in all, consisting of triangles, squares, and circles, colored red, yellow, and blue, so that each shape appears once in each of the three colors. It was emphasized that (*a*) the series contains each of these nine possibilities; (*b*) the order is always the same; and (*c*) adjacent items in the series were never of the same shape or the same color. For example, if a red triangle appeared, it could not be followed either by a triangle or by any figure

colored red. The *S*s were to make their anticipations by saying the color and the shape, e.g., *red circle*. Each series began with three small white dots against a black background as the signal to make the first anticipation. The *S*s continued in the task until they attained one trial in which all nine items in the series were anticipated correctly. The stimuli were presented automatically by a Bausch and Lomb apparatus which projects the stimuli from behind onto a ground-glass screen 2ft. square.The stimuli were approximately 4 in. in size on the screen and the colors were vivid. *S*s were tested individually. The *S*s sat directly facing the screen at a distance of 12 ft. The experimenter sat at a desk several feet to the side of the *S*s.

For 32 *S*s the stimuli were presented at a 4 sec. rate with a 12 sec. intertrial interval. For the other 32 *S*s the stimuli were presented at a 2 sec. rate with a 6 sec. intertrial interval.

RESULTS

The experimental design used here does not permit a statistical comparison between Neuroticism and Extraversion or an assessment of their interaction. It was intended only to test the interaction of each personality variable with the task-difficulty variable, about which theoretical predicions have been made.

The measure of learning was the *S*'s total number of errors (omissions and incorrect responses) during the course of learning the serial list to the criterion of one perfect trial. Essentially the same results would have been obtained if the number of trials required for mastery were used as the measure of learning, since the correlation between errors and trials was .92. The results for each group, in terms of mean error score, are presented in Table 1 (line 3) and are shown graphically in Fig. 1.

Neuroticism. As can be seen in Fig. I, the High and Low N groups hardly differ in learning at the slow (4 sec.) rate of stimulus presentation; in fact, the High N *S*s do somewhat better (i.e. make fewer errors) than the Low N *S*s. Under the fast (2 sec.) rate of presentation, however, the High and Low N groups widely diverge. The Low N *S*s are only slightly hindered by the fast rate, while the High N *S*s are greatly hindered in learning.

Since the High and Low N groups differ slightly in extraversion, the statistical analysis was carried out by analysis of covariance, which has the advantage of removing the effects of extraversion when comparing the learning scores of the High and Low N groups. The analysis of covariance (Table 2) indicates that the effect of rate of presentation is statistically significant and that the interaction of neuroicism and rate

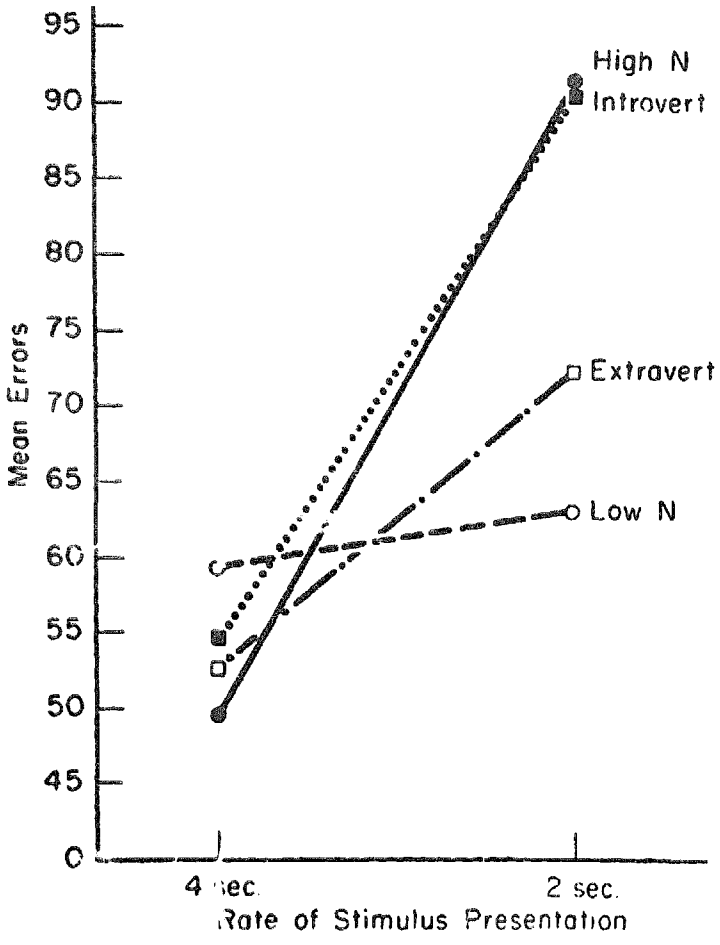

Fig. 1.
Mean errors during learning of high and low scores on the N and E scales of the MPI under 4 sec. and 2 sec. rates of stimulus presentation.

of presentation is significant at the 1 per cent level by a two-tailed test. Table 1 (line 4) gives the adjusted mean error scores, that is, the means after the effects of extraversion have been removed. These adjusted means are shown graphically in Fig. 2. As can be seen, the interaction between neuroticism and task difficulty clearly remains after the effect of the extraversion dimension has been statistically eliminated. The overall correlation within the High and Low N groups between extraversion and errors in learning was -.31.

Extraversion-Introversion. The results for Extraverts and Introverts are shown also in Table 1 and Fig. 1. An analysis of covariance was performed on these data to remove statistically the effects of neuroticism. The covariance analysis (Table 3) indicates that Extraverts and Introverts do not differ significantly in learning and that there is not a statistically significant interaction between rate of stimulus presentation and Extraversion-Introversion. Fig. 2 graphically shows the adjusted mean errors

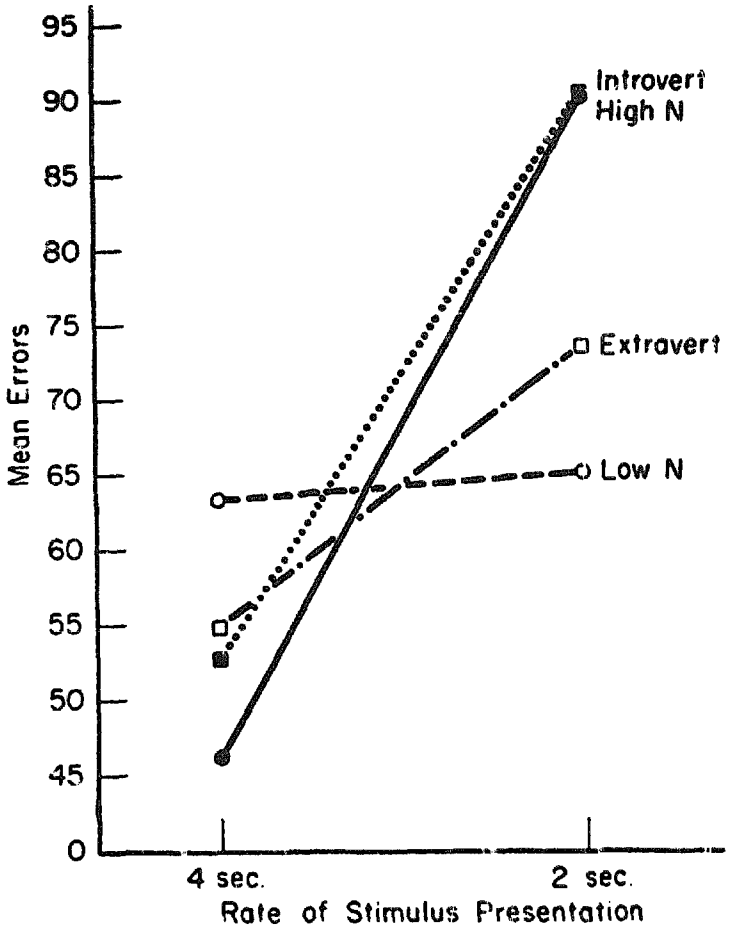

Fig. 2.

Mean learning errors adjusted by analysis of covariance, showing differences between high and low scorers on N and E under 4 sec. and 2 sec. rates of presentation. The covariance adjustment statistically eliminates the effects due to one of the personality variables, so that when High and Low N groups are compared the effects of extraversion-introversion are removed, and when extraverts and introverts are compared the effects of neuroticism are removed.

TABLE 2

Analysis of Covariance of Error Scores in Serial Learning Made by High and Low Neuroticism Groups, with Effects of Extraversion-Introversion Eliminated

Source	*df*	*MS*	*F*	Significance Level
Rate (R)	1	8862.49	8.48	$P < .01$
Neuroticism (N) . .	1	218.45	0.21	n.s.
R X N	1	7850.01	7.51	$P < .01$
Error	59	1045.68		

for Introverts and Extraverts after the effects of neuroticism have been statistically removed. The overall correlation within the Introvert and Extravert groups between neuroticism and errors in learning was .19.

Neither in neuroticism nor in Extraversion-Introversion did the covariance adjustment make an appreciable difference in the results.

TABLE 3

Analysis of Covariance of Error Scores in Serial Learning Made by Extraverts and Introverts, with Effects of Neuroticism Eliminated

Source	*df*	*MS*	*F*	Significance Level
Rate (R)	1	12344.23	17.04	$P < .001$
Extraversion (E) . .	1	835.27	1.15	$P < .28$
R X E	1	1418.15	1.96	$P < .16$
Error	59	724.24		

Serial-Position Effects. The serial-position curves (i.e. the proportion of errors made at each position in the series) were determined for each group (High N, Low N, Extravert, and Introvert). All the curves were typical of the serial-position effect and all were nearly identical in shape, both in degree of "bowing" and in skewness.[2] The curves were so much alike as to obviate testing the very slight, nonsystematic differences for statistical significance.

DISCUSSION

The interaction of neuroticism with task difficulty in serial learning has been clearly borne out in accord with the Spence-Taylor hypothesis that anxiety facilitates the learning of easy tasks and disrupts the learning of more difficult or complex tasks. The Neuroticism scale of the Maudsley Personality Inventory thus appears to measure much the same anxiety-drive condition as is measured by the Taylor Manifest Anxiety Scale.

The results for extraversion-introversion were statistically non-significant, although the extraverts performed somewhat better under the stress of the 2 sec. rate than did the introverts, which is contrary to what might be expected in terms of Eysenck's theory that extraverts build up reactive inhibition more rapidly than do introverts. Responding at the 2 sec. rate would presumbably create more reactive inhibition than the 4 sec. rate. In view of the recent work of Underwood (13) on the mechanisms underlying the differences in rote learning produced by massed and distributed practice, however, it seems very likely that reactive inhibition by itself is an inadequate explanation. Hence an experiment designed to assess the interaction between extraversion-introversion and distribution of practice

[2] The rationale and method for comparing serial-position curves have been discussed by the writer elsewhere (9).

in rote learning is probably not an appropriate test of Eysenck's reactive inhibition theory of extraversion-introversion.

The same may be said of Eysenck's prediction (2, p. 146) that extraverts should produce a more markedly bowed serial-position curve than do introverts. This prediction was based on Hull's theory that the bowing of the serial-position curve is a result of a greater amount of inhibition building up in the middle of the list (6). Since Hull's theory of the serial-position effect has not been supported by research and is even contradicted by recent findings (4, 5, 8), a comparison of the shapes of the serial-position curves of extraverts and introverts is probably irrelevant to Eysenck's theory of extraversion-introversion.

SUMMARY

University students scoring either high or low on the Neuroticism and Extraversion scales of the Maudsley Personality Inventory were compared on serial learning tasks under 4 sec. and 2 sec. rates of stimulus presentation. A highly significant interaction between task difficulty (controlled by the presentation rate) and neuroticism was found. At the slow rate (4 sec.) High and Low N groups did not differ appreciably in learning. The fast rate (2 sec.) of presentation, however, greatly hindered the learning of the High N group but had hardly any adverse effect on the learning of the Low N group.

Extraversion did not show a statistically significant interaction with the learning variables.

No systematic differences were found between the shapes of the serial-position curves of any of the groups.

The results were discussed in terms of the Spence-Taylor anxiety-drive hypothesis and Eysenck's theory of extraversion-introversion.

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